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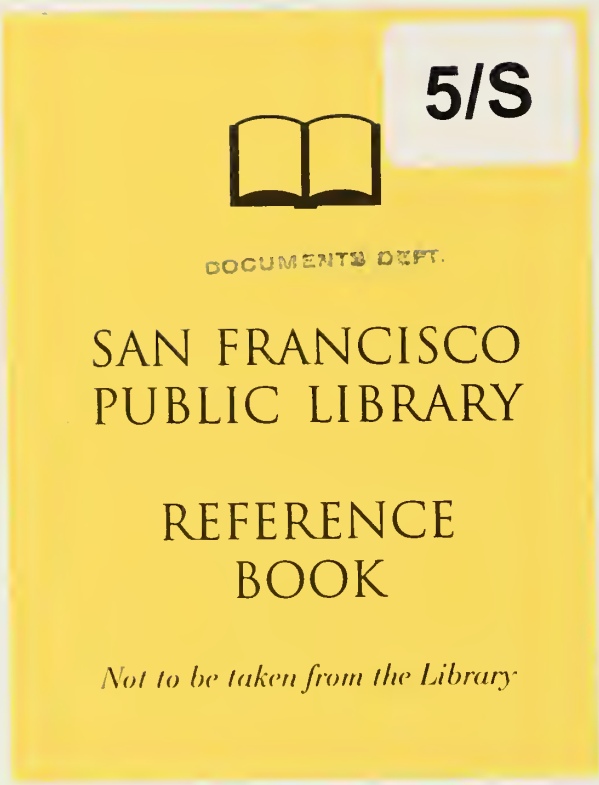

SEPTEMBER 1995

CALTRAIN SAN FRANCISCO
DOWNTOWN EXTENSION PROJECT
CONCEPTUAL DESIGN AND DRAFT EIS/EIR

Engineering and Architectural Design Criteria Report

PENINSULA CORRIDOR JOINT POWERS BOARD

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CALTRAIN TERMINAL ALTERNATIVES
MISSION BAY
CHINA BASIN
MOSCONE CONVENTION CENTER
CIVIC CENTER STATION
POWELL ST. STATION
MONTGOMERY ST. STATION
EMBARCADERO STATION
FERRY BLDG.
BAY BRIDGE
THE EMBARCADERO
MISSION ROCK
ALABAMA ST.
FLORIDA ST.
BRYANT ST.
UTAH ST.
BRUNO AVE.
VERMONT ST.
DE HARO ST.
LEAVENWORTH
JONES
TAYLOR
MASON
POWELL
STOCKTON
GRANT
KEARNEY
MONTGOMERY
SANSOME
BATTERY
FRONT
DAVIS
DRUMM
MISSION ST.
7TH ST.
6TH ST.
5TH ST.
4TH ST.
3RD ST.
2ND ST.
1ST ST.
BRYANT
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TOWNSEND
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HOOPER ST.
IRWIN ST.
HUBBELL ST.
DAGGETT
OWENS ST.
CHANNEL
16TH ST.
ILLINOIS ST.
CHINA BASIN ST.
ZOE ST
RITCH ST
SOUTH PARK
STANFORD
COLIN P. KELLY ST.
DELANCEY ST.
BERRY
HAWTHORNE
ESSEX ST.
NEW MONTGOMERY
FREMONT
BEALE ST.
MAIN
SPEAR
FOLSOM
HARRISON
HOWARD
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ALAMEDA ST.
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DIVISION ST.
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10TH ST.
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8TH ST.
MCALLISTER
GOLDEN GATE
TURK
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CALTRAIN SAN FRANCISCO DOWNTOWN EXTENSION PROJECT
CONCEPTUAL DESIGN AND DRAFT EIS/EIR

ENGINEERING AND ARCHITECTURAL DESIGN CRITERIA REPORT

PREPARED FOR THE

PENINSULA CORRIDOR JOINT POWERS BOARD

PREPARED BY
ICF KAISER ENGINEERS

IN CONJUNCTION WITH

DE LEUW, CATHER & COMPANY
GENSLER AND ASSOCIATES
FINGER & MOY

September 27, 1995

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A. INTRODUCTION - PURPOSE AND NEED FOR PRELIMINARY DESIGN CRITERIA

The purpose of this report is to establish preliminary design criteria for the various major elements of geometric, architectural, structural and ventilation design required to prepare engineering and architectural drawings and cost estimates for the EIS/EIR. We have also included some very preliminary guidelines from the San Francisco Fire Department (SFFD).

Though the present development of drawings and cost estimates is only at the conceptual design level, the criteria adopted at this time will form the basis to be used during more detailed design in the future. Therefore, coordination has been initiated with the Peninsula Corridor Joint Powers Board (PCJPB), the California Public Utilities Commission (CPUC), the City of San Francisco, Caltrans, and other involved agencies in developing the guidelines contained herein.

The proposed geometric design criteria to a large extent is based on the criteria presently established by the PCJPB and contained in Volumes I and II, Standards, with additional comments by the JPB's on-call railroad engineering consultants, the Woodside Consulting Group. The maximum dimensions of the proposed cross section of the subway portions of the project are currently being reviewed by the Utilities Safety Division of the CPUC for compliance assuming that 25 kVA AC electrification of the JPB Peninsula Commute Service were to occur. The 3'-2" width of the emergency walkways within the subway sections is per the SFFD. The architectural criteria is based on standard rail transit subway station design, with specific recommendations based on the requests of the PCJPB and requirements of the City and County of San Francisco. The structural design criteria is standard for above and below-ground structures carrying railroad traffic, and is current with the most recent seismic design criteria being used within the State of California.

Finally the ventilation design criteria has needed to be very comprehensive because of the variety of energy sources being considered for the operation of commuter trains in subways. The criteria is very state-of-the-art and is based on the experience of staff involved in the final design of similar systems throughout the U.S.A. and Canada.

B. GEOMETRIC DESIGN CRITERIA

1.0 CRITERIA AND RECOMMENDED PRACTICES

Commuter rail facilities must conform to the following standards:

- Peninsula Corridor Joint Powers Board (PCJPB) Design Standards, Volumes I & II.
- American Railway Engineering Association (AREA) Manual for Railway Engineering.
- AREA Portfolio of Trackwork Plans.
- All applicable Federal Railroad Administration (FRA) rules, regulations, and procedures.
- Applicable requirements of the California Public Utilities Commission (CPUC).
- Applicable requirements of the Americans with Disabilities Act (ADA) of 1990.

2.0 CLEARANCES

2.1 INTRODUCTION

Minimum horizontal and vertical clearances are prescribed by the California Public Utilities Commission (CPUC) General Order 26-D for railroads.

2.2 TRACKWAY CLEARANCE ENVELOPE

Since the approaches to the downtown San Francisco CalTrain terminal will be used only for passenger rail operations, the tangent track clearance envelope prescribed by the CPUC for railroads not transporting freight cars shall apply and is summarized below:

- Spacing between main tracks = 14 ft - 0 in
- Horizontal clearance to walls = 8 ft - 6 in
- General vertical clearance (electrified track) = 19 ft - 3 in

Lateral clearances adjacent to curved track shall be increased 1.5 inches per degree of curvature. Track centers shall be widened on curves by 2 inches per degree of curvature.

3.0 GEOMETRICS

3.1 INTRODUCTION

Railroad alignments shall be designed in conformance to the requirements of the PCJPB Standards, Volumes 1 and 2, and the AREA Manual for Railway Engineering.

3.2 HORIZONTAL ALIGNMENT

The horizontal alignment for railroad tracks shall consist of tangents, circular curves and spiral transitions based on an appropriate design speed. The preferred design speed for the down-town extension shall be 40 mph, except at the approaches to the terminal station where a reduced design speed of 10 mph is appropriate.

3.2.1 Tangent Alignment

For main tracks, the desirable tangent length between the points of spiral of any two curves shall be 120 feet, with a minimum value of 85 feet (one gallery car length).

3.2.2 Circular Curves

Curves shall be defined by the 50-ft chord definition and specified by their degree of curvature. The desirable maximum degree of curvature for main tracks shall be fourteen degrees (14°). An absolute maximum degree of curvature shall be sixteen degrees (16°) where absolutely necessary for a reduced design speed of 20 mph or less.

The minimum length of circular curves for main tracks preferably shall be 100 feet. As a practical limitation, circular curves will not be provided when the intersection angles are less than 30 minutes.

3.2.3 Spiral Curves

Spiral transition curves shall be used for main line tracks only. Spiral curves shall conform with the AREA ten-chord spiral.

The minimum length of a spiral shall be determined from the following formulas (rounded off to the nearest 10 feet):

1. $Ls\ (min) = 1.22\ Eu\ V$ 2. $Ls\ (min) = 62\ Ea$

Where Ls = Spiral length in feet
Ea = Actual superelevation in inches
Eu = Unbalanced superelevation in inches
V = Curve design speed in mph

In using the above formulas, the maximum length of spiral produced by the two formulas shall be used.

3.2.4 Superelevation

Superelevation shall be provided on main tracks only, based on the following formula:

$$Ea = 0.0007\ V^2\ D - 3"$$

Where Ea = Actual elevation in inches
V = Curve design speed in mph
D = Degree of curvature

Values of actual superelevation shall be rounded to the nearest one-quarter inch (1/4"). Actual superelevation shall not exceed six inches.

See PCJPB Standards, Section 5, Exhibit 3, for maximum allowable operating speeds on curves.

3.3 VERTICAL ALIGNMENT

The profile grade shall be defined as the elevation of the top of low rail. Vertical curves shall be defined by parabolic curves having a constant rate of grade change.

The desirable minimum length of vertical tangents shall be 300 feet, with an absolute minimum value of 100 feet.

3.3.1 Maximum/Minimum Gradients

The maximum grade shall be 3% for a train consist of one locomotive and seven coaches and for a reduced design speed of 10 mph. This maximum grade shall be compensated on horizontal curves by reducing the profile grade by 0.04% for each degree of curvature.

3.3.2 Vertical Curves

Length of vertical curves shall be determined as follows (rounded off to the next largest hundred feet):

$$L = D / R$$

Where L = Length of vertical curve in 100 ft. stations
R = Rate of change per station
D = Algebraic difference of grades in percent

At the approaches to the downtown terminal, a desirable rate of change of 0.5% per station shall be used: the maximum rate of change shall be 5.0% per station. The desirable minimum length of vertical curves shall be 100 feet.

3.4 SPECIAL TRACKWORK

Turnouts and crossovers shall be preferably located on horizontal and vertical tangents. Turnouts or crossovers shall be No. 10, with an absolute minimum of No. 7.

3.5 STATIONS

Station platforms shall be 1,000 feet long. The inside edge of platforms shall be 4 feet, 8 inches from centerline of track, and the height of platform shall be 8 inches above top of rail. The absolute minimum widths of platforms shall be 15 feet for side platforms and 28 feet for center platforms. Actual widths shall be determined by maximum passenger loads assuming a minimum of 7 square-feet-per passenger.

Stations shall be located on horizontal tangents and constant vertical gradients. Horizontal tangents and constant vertical gradients, free of special trackwork, shall be extend 500 ft. beyond the limits of the 1,000 ft. station platforms wherever possible; the absolute minimum distance shall be 85 ft.

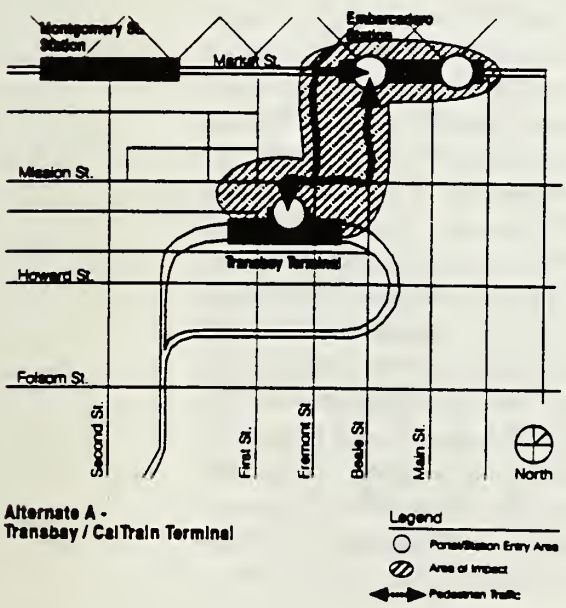
There is no minimum gradient through passenger stations. The maximum gradient shall be 0.2% through stations.

C. ARCHITECTURAL DESIGN CRITERIA

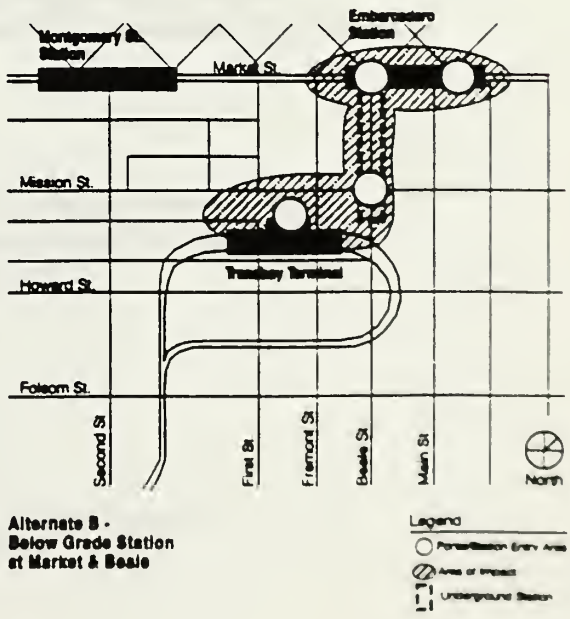
1.0 Introduction

The extension of CalTrain into downtown San Francisco provides an important link to the primary commuter transit systems serving the Bay Area. This link could significantly increase ridership on BART, MUNI and CalTrain as well as enhance the revitalization of the Transbay Area. As part of the EIS/EIR process for evaluating the extension, preliminary architectural concepts will be developed for the alternatives being reviewed. The following Design Criteria Technical Memorandum will be utilized to provide a basis for preparing the preliminary architectural concepts as well as to ensure general compliance with existing ordinances and regulations for the terminal station and the surrounding terminal station area. Key parts of the memorandum are also intended to form the basis for evaluating the aesthetic / visual impacts section of the EIS/EIR.

Each section in the document has been structured to provide a brief description of the section, the goals or intent of the criteria listed, and a set of principles to guide the design toward achieving the stated intent. Where appropriate, standards and/or precedents have also been provided. The standards provide specific guidelines (such as size, speed, etc.) for a particular element and the precedents illustrate examples of where the principles or standards have been used on other similar projects. The criteria listed is intended to be general in nature, corresponding to the preliminary scope of the architectural design, while providing the basis for development of detailed criteria for use in preparing design development and final construction documents. Since the EIS/EIR is evaluating alternative station locations (see figures below), the criteria is applicable to each of the alternatives, unless otherwise noted). For purposes of this memorandum, the alternatives have been identified as the Existing Transbay Terminal Station (TT) Alternative and the Subway Alternative.



Alternate A - Transbay / CalTrain Terminal



Alternate B - Below Grade Station at Market & Beale

The criteria are general guidelines for design rather than a set of rules. The purpose is to maximize transit patronage by optimizing convenience, ease of access, safety, and aesthetic appeal for users in an efficient, cost effective manner. The guidelines will help minimize environmental impacts, ensure compatibility with the surrounding area, and enhance business opportunities.

2.0 Codes and Regulations

2.1 INTRODUCTION

This section provides a list of key applicable codes, regulations and related planning documents which affect the overall planning and design of the CalTrain station terminal to the level appropriate for evaluation in the EIS/EIR document. Key sections of the list have been expanded upon for a discussion of general design principles and are shown in bold face type.

2.1.1 INTENT

a. To identify the key applicable codes, standards, and regulations which may affect, regulate or influence the preliminary design of the CalTrain terminal station and surrounding terminal station area, and which will help guide the development and implementation of the criteria listed in this memorandum.

b. To create a terminal station environment that is accessible, safe, secure and free from recognized hazards.

2.2 LIST OF KEY APPLICABLE CODES AND REGULATIONS

American National Standards Institute (ANSI)
The Americans with Disabilities Act (ADA)
American Public Transit Association (APTA) - Rapid Transit Design Guidelines
American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE)
American Society of Mechanical Engineers (ASME)
American Society of Testing and Materials (ASTM)
California Code of Regulations (CCR), Title 8
California Code of Regulations (CCR), Title 19
California Code of Regulations (CCR), Title 24, Part 2 (State Building Code)
California Building Standards Code, Suggested revisions August 1995, Section 414A
California Public Utilities Commission (CPUC) General Orders
City of San Francisco Planning Code
City of San Francisco Zoning Maps
City of San Francisco Height and Bulk District Maps
City of San Francisco Fire Codes
Institute of Electrical and Electronic Engineers (IEEE)
Manual for Railway Engineering
National Fire Protection Association 13 Installation of Sprinkler Systems
NFPA 14 - Installation of Standard Pipe and Hose Systems
NFPA 70 - National Electric Code (NEC)

NFPA 90A - Installation of Air Conditioning and Ventilating Systems
NFPA 91 - Blower and Exhaust Systems
NFPA 101 - Life Safety Code
NFPA 110 - Emergency and Standby Power System
NFPA 110A - Stored Electrical Energy Emergency and Standby Power System
NFPA 130 - Fixed Guideway Transit Systems
NFPA 220- Standards on Types of Building Construction
Occupational Safety and Health Act (CAL-OSHA)
Subway Environmental Design Handbook Vol. 1, 2nd Edition
Uniform Building Code (UBC) 1994
Uniform Mechanical Code
Uniform Plumbing Code

2.2.1 ADA/CCR TITLE 24

The federal Americans with Disabilities Act (ADA) of 1990 requires public operators of fixed route transit systems to provide systems and vehicles which meet a set of specified accessibility criteria. The ADA makes it illegal to discriminate against the disabled in the provision of access. The prohibitions against discrimination are articulated in four specific titles. For purposes of this project, Title II will be the primary regulatory influence. These regulations are to be consistent with the Architectural and Transportation Barriers Compliance Board (ATBCB) ADA guidelines in the federals Section 504 of the Rehabilitation Act. Title II of the ADA requires access to services, programs, and activities to be provided by public entities in all cases except where an undue burden is created. The definition of "undue burden" contained in the ADA is flexible and subject to interpretation on a case-by-case basis. Program access is required in all cases except where access would result in a fundamental alteration in the nature of the program or an undue financial or administrative burden. In the case of a new terminal station facility, this would not likely be the case. For the Transbay Terminal, as an existing facility, access issues would be subject to greater interpretation/flexibility.

The key element of the Act to be addressed in the implementation of the CalTrain program involves the terminal station and vehicles, and broadly requires that disabled individuals must be provided access throughout the station and to any public services which are part of the station, and therefore to the station platforms and into the vehicles. This means that fully accessible elevators or ramping systems must be provided from an accessible area to the station platforms. In the case of the station guidelines described in Section 8.0 of this document, elevators have been provided as an integral component of the vertical circulation system for each station platform. Access to the elevators, both at grade and from the station platforms, shall not contain any obstacles to accessibility. This would include alignments of the platform and the vehicle, which would allow the disabled individual to go from the platform to the vehicle in an unobstructed manner. There are two sections which will more than likely be reviewed in evaluating accessibility to the system. The first is new construction, including the station areas and the vehicles themselves. The second will be access to the station areas. The following lists major areas which may be subject to review as part of the ADA evaluations:

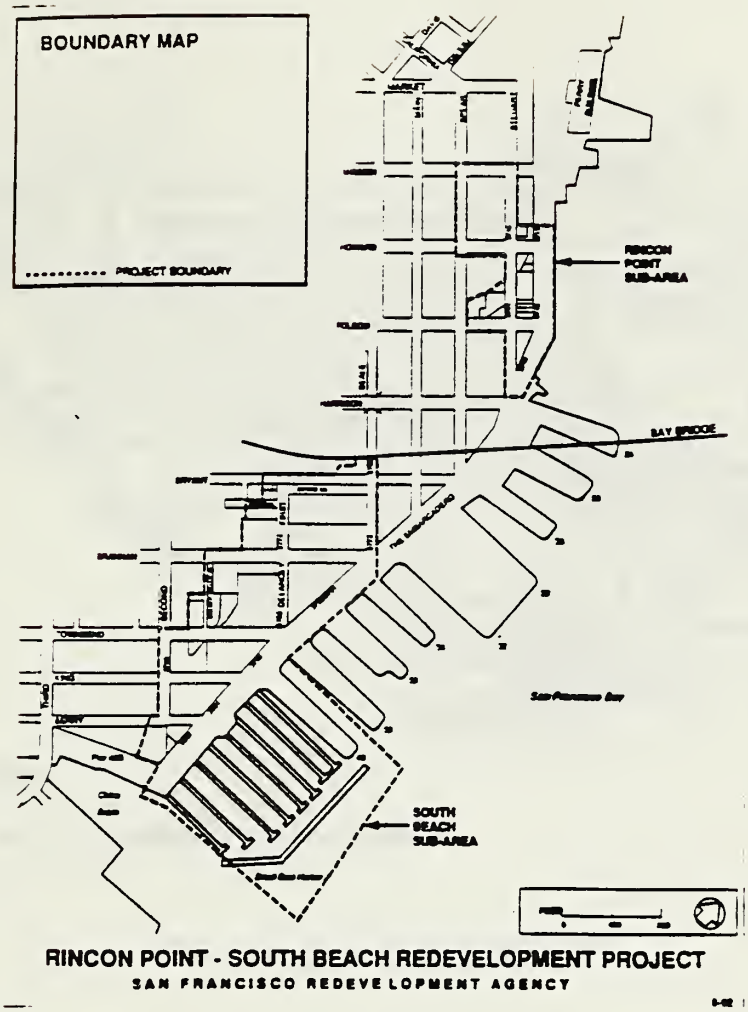
- Site access
- Passenger loading zones/bus stops
- Parking areas
- Curved ramps
- Entry/exit doors
- Corridors and accessible routes
- Interior doors
- Ramps
- Stairs
- Areas of rescue or assistance
- Elevators
- Ticket counters
- Ticket vending machines
- Drinking fountains
- Toilet rooms
- Alarms
- Detectable warning strips
- Signage
- Telephones
- Audible and visual warning signals

Section 3.0 of this document provides a set of standards which incorporates key elements of the ADA and Title 24 for use in determining station design. These standards contain specific design provisions for the reduction or elimination of barriers that impede the use of the system by the disabled.

2.2.2. NFPA 130 - Standard for Fixed Guideway Transit Systems, 1993

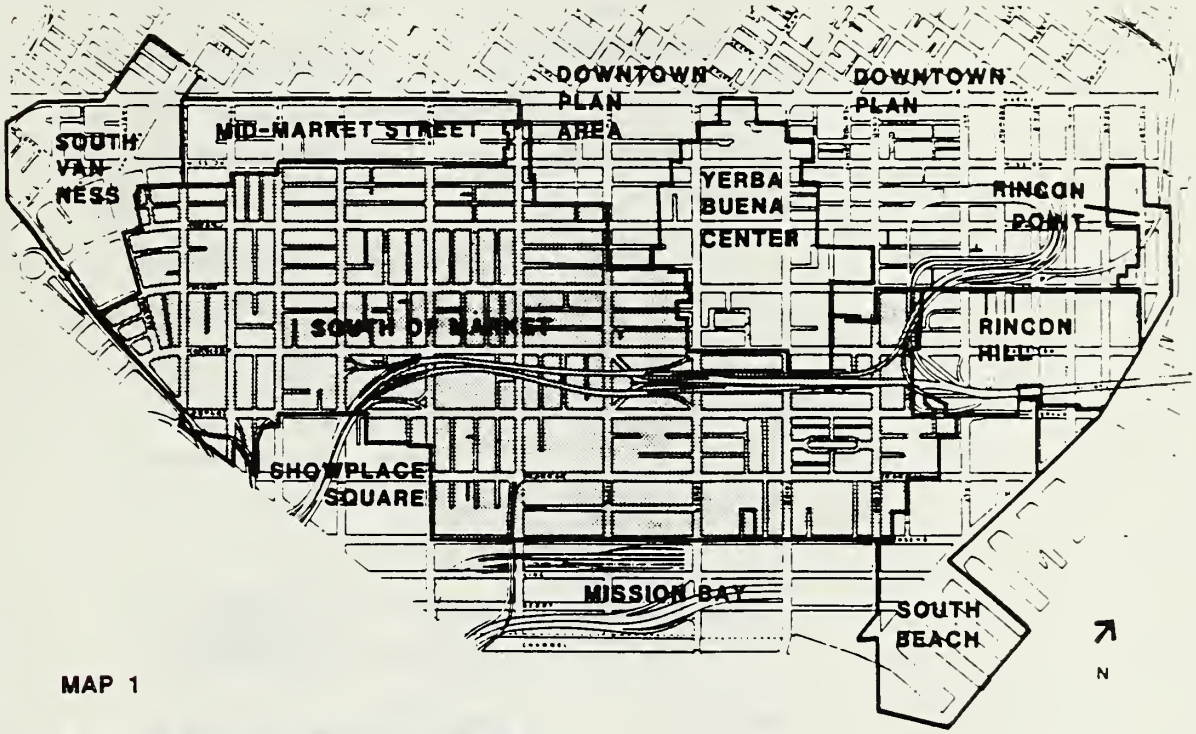
Typically, code requirements are determined by the Uniform Building Code (UBC), and based around the guidelines developed in NFPA 101, Code for Life Safety From Fire in Buildings and Structures. NFPA 130 modifies NFPA 101 and was developed to address the unique and specific conditions for fire and life safety presented by fixed guideway transit systems. The focus of NFPA 130 is on the areas within a rapid transit system including vehicles, trainways, subways, underground stations, and above ground stations. Principles and standards contained within NFPA 130 are incorporated in Section 3.0, User Access and Circulation.

2.2.3 City of San Francisco Planning Code



2.2.4 Rincon Point South Beach Redevelopment Plan

The Rincon Point - South Beach Redevelopment Plan outlines a framework for the redevelopment of the area in conjunction with the Rincon Point - South Beach Redevelopment Project Area - Design for Development. The two documents together provide a series of proposed actions to alleviate the blighted condition of the existing area, a land use plan encompassing commercial and residential uses and a major park, and design development guidelines.



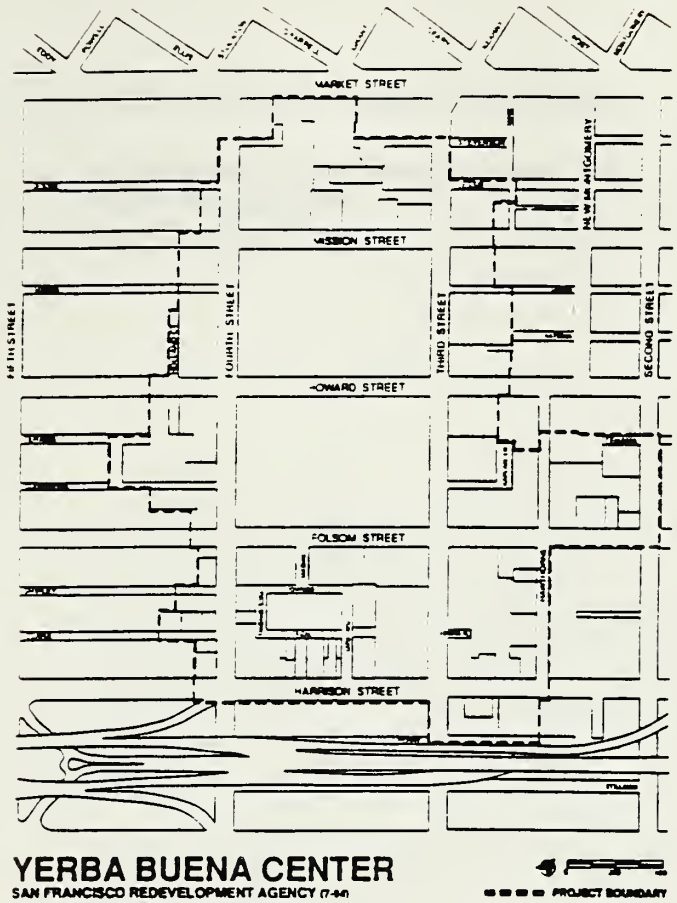
MAP 1

SOUTH OF MARKET PLANNING AREAS

The San Francisco Master Plan

2.2.5 South of Market Plan

The South of Market Plan is an area plan of the Master Plan of the City and County of San Francisco. The document contains goals, objectives and policies for the conservation and development of the South of Market area of San Francisco. The Plan is accompanied, in a separate document, by proposed permanent zoning controls (Planning Code amendments which would set forth the rules for new development. The plan will guide the location, intensity and character of new and expanded business and residential activity, the buildings which house those activities, and the public facilities and resources provided within the area covered in the Plan.



MAP 1
PROJECT AREA BOUNDARIES

2.2.6 Yerba Buena Center Redevelopment Plan

The Yerba Buena Center Redevelopment Plan outlines a framework for the redevelopment of the area in relation to the existing Yerba Buena Center and the adjacent downtown areas. The surrounding Plan area is characterized by blight and an incompatible mixture of uses. The Plan provides a series of proposed actions to rehabilitate the area and encourage private investment. A land use plan encompassing commercial, residential, light industrial and public uses, in accordance with the Master Plan of the City and County of San Francisco, is provided along with design development guidelines.

2.3 OTHER APPLICABLE POLICY DOCUMENTS

City and County of San Francisco Master Plan
Mission Bay Plan FEIR
Rincon Hill Plan DEIR

3.0 User Access and Circulation

This section addresses the general requirements for passenger movement up to and within the station. The guidelines provided herein are intended to form the basis for the conceptual station planning and the layout of the major pedestrian elements of the station. For each of the alternatives evaluated in the EIS/EIR, access to the station platform will be via vertical circulation elements - i.e., elevations, escalators and stairs.

3.1 PEDESTRIAN ACCESS AND CIRCULATION

3.1.1 INTENT

a. To provide for the safety and convenience of patrons while arriving and departing from the station site.
b. To provide clear, convenient, efficient and minimally restricted access and circulation patterns at both street level and transferring passenger levels.
c. To provide easy access to and egress from the station entrances.
d. To provide an unassisted base of access for the disabled.

3.1.2 PRINCIPLES

a. A safe, direct approach and line of travel for pedestrians should be provided from all adjacent streets into the terminal station area, to the ticketing areas and on to the platform.
b. Pedestrian crossings should have good visibility both for patrons and vehicles.
c. The public entrances to the station should be a covered element. At underground stations, stairs and/or escalators leading directly to the ticketing level should be provided, as well as an elevator for disabled access.
d. A convenient drop-off / loading area should be provided to accommodate passengers (including parcels and luggage) using demand responsive transportation (taxis, autos, etc.).
e. Interconnection access between the CalTrain terminal station and other nearby transit system stations should be provided at the mezzanine level.
f. Direct pedestrian access from adjacent buildings should be provided wherever feasible and desirable.
g. The station design should minimize pedestrian walktimes to/from transit vehicles and walktimes to/from the street.
h. A way-finding system for the disabled and visually-impaired should be provided. All access and circulation elements should meet or exceed ADA standards.
i. Dead-end conditions shall be avoided.

3.1.3 STANDARDS

a. Site access: Site development shall provide access and path of travel as defined in ADAAG and Title 24, including provision of pedestrian ramps, curb ramps and / or elevators. Walks and ramps shall be a minimum of 5'-0" wide.

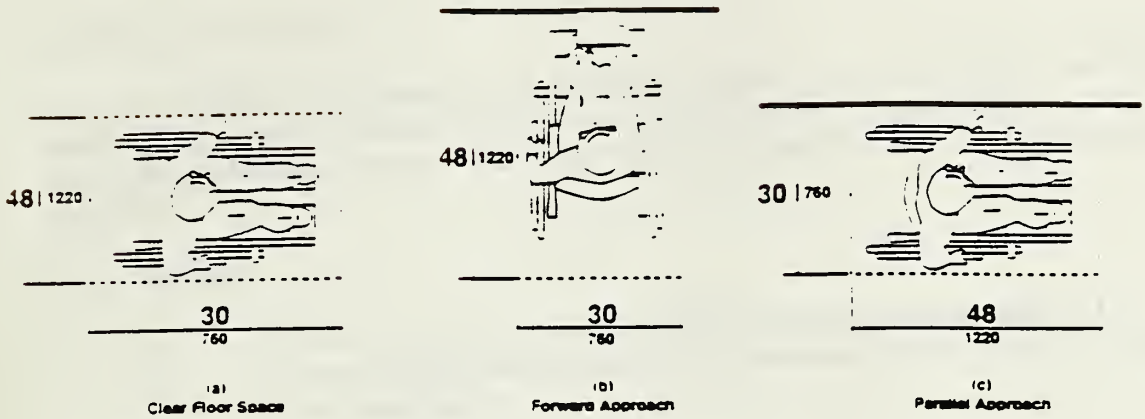
b. Entrances

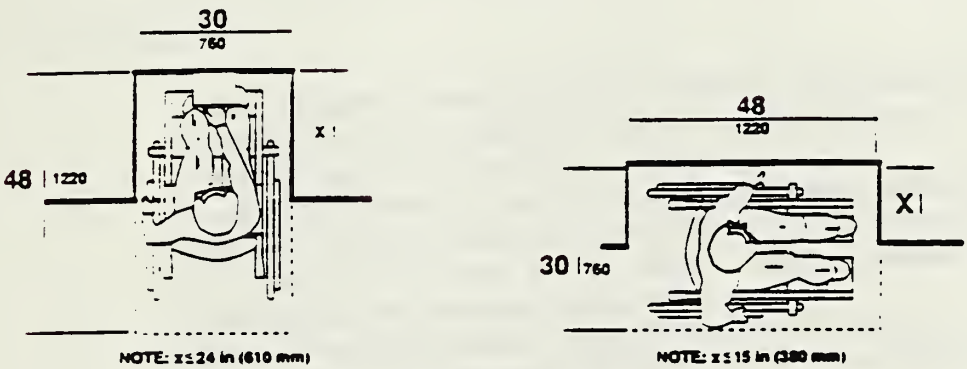
- All entrances to buildings and facilities shall be made accessible to individuals with disabilities. Entrances shall be level and provide a minimum of 5 feet clear on each side of the entrance. Finishes shall be slip resistant.
- Entrances shall be designed to allow for closing and securing the station during off hours and during emergencies.

c. Exiting

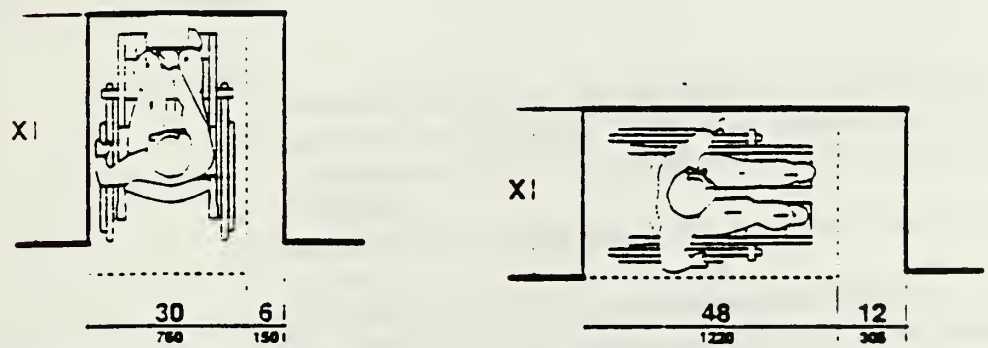
- Whenever possible, provide separate paths for exiting and entering patrons.
- Barrier free, self-service ticketing and access (no fare gates or turnstiles).
- 300' max. to any exiting element.
- Provide stairs and escalators together to allow for varying speeds of passengers and for minimal disruption of circulation in the event of mechanical failures.

3.1.4 Precedents





(d)
Clear Floor Space in Alcoves


X
30
760
6
150
NOTE: If x > 24 in (610 mm), then an additional maneuvering clearance of 6 in (150 mm) shall be provided as shown.
X
48
1220
12
305
NOTE: If x > 15 in (380 mm), then an additional maneuvering clearance of 12 in (305 mm) shall be provided as shown.

(e)
Additional Maneuvering Clearances for Alcoves

ADA Guidelines
Minimum Clear Floor Space for Wheelchairs

3.2 VERTICAL CIRCULATION

For new construction, the primary means of vertical circulation will be by escalators, with stairs providing supplementary circulation and elevators providing access for disabled passengers. For the existing Transbay Terminal, stairs and ramps provide the primary means of vertical circulation.

3.2.1 INTENT

a. To provide a general set of requirements for preliminary station planning.
b. To ensure that adequate space and clearances are provided for smooth, efficient passenger flow.

3.2.2 PRINCIPLES

a. Vertical circulation elements should be located to carry passengers as directly as possible to or from the platform area at a location convenient for passengers to board the train or exit the station.
b. Elevators are provided for disabled passengers, or those requiring some level of assistance. They are not intended as a primary means of circulation.
c. For security and passenger control, vertical circulation elements shall not be continuous between mezzanine and street levels.
d. Stairs and escalators shall be "grouped" to provide for varying travel speeds of patrons, as well as to provide efficient structural and space utilization.

3.2.3 STANDARDS

a. Stairs
- Minimum width is 44" (actual width is to be determined by exiting requirements). Stair widths should be planned whenever possible in increments of 22" for use as an exit lane in emergency evacuation calculations.
- Stair steps have a minimum 4" and maximum 7" rise; and a minimum 11" run.
- Stairs wider than 88" require an intermediate handrail for each 88".
- Each stairway shall have continuous handrails on each side, with the top of the handrail placed no less than 34" nor more than 38" above the nosing of the treads.
- Continuous stair runs may not exceed 12 feet vertically without providing a landing. For stairs exceeding 12 feet vertically, a landing should be provided at approximately half the vertical distance.

b. Handrails
- The nominal diameter or gripping surface of a handrail shall be between 1 1/4" and 1 1/2".

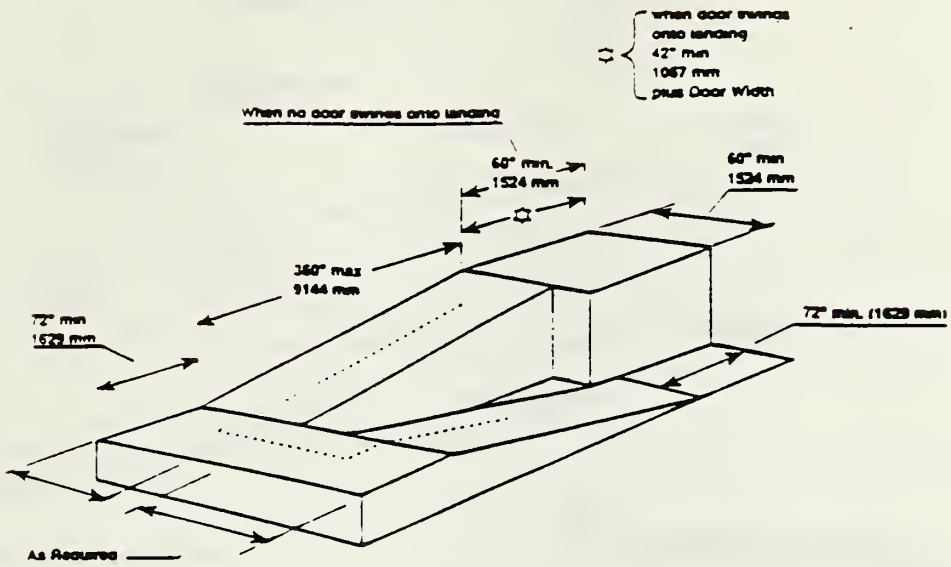
- Handrails shall be continuous and shall extend a minimum of 12" past the upper nosing of each stair run and 12" plus the tread width past the lower nosing for all stairs; they shall extend a minimum of 12" past the edge of landings for all ramps.

c. Landings
- Landings must be at least as wide as the width of the stair, measured in the direction of travel.

d. Ramps
- Any path of travel with a slope exceeding 1:20 (5%) shall be considered a ramp.
- Ramp widths and handrail requirements (excluding intermediate handrails) are the same as for stairs.
- The slope of ramps shall not exceed 1 vertical to 12 horizontal, and shall comply with the provisions of the ADA and CCR Title 24, Part 2.
- Landings shall be provided at the top and bottom of each ramp run, with at least one intermediate landing for each 2 1/2 feet of rise and each change of direction. Top and intermediate landings shall be at least 5 feet in width, measured in the direction of the ramp run. Landings at the bottom of ramps shall be at least 6 feet, measured in the direction of the ramp run.
- Ramp handrails shall be provided on each side of any ramp whose slope exceeds 1:20 or whose rise is greater than 6 inches.

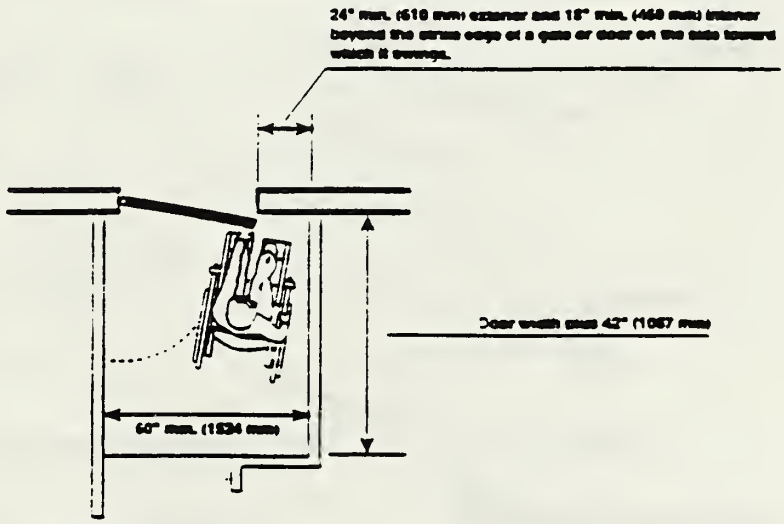
e. Elevators
- Elevators shall be sized to accommodate a hospital gurney.
- Elevators shall comply with ADA regulations.
- Glass panels or enclosures shall be provided in elevators for visual security.

f. Escalators
- Speed: 120 FPM, reversible
- Width: 48" nominal width
- Capacity: 135 PPM (see 3.3.3 for use in exiting)
- Escalators not located inside to a building or protected by an enclosed shelter shall be of weatherproof design.



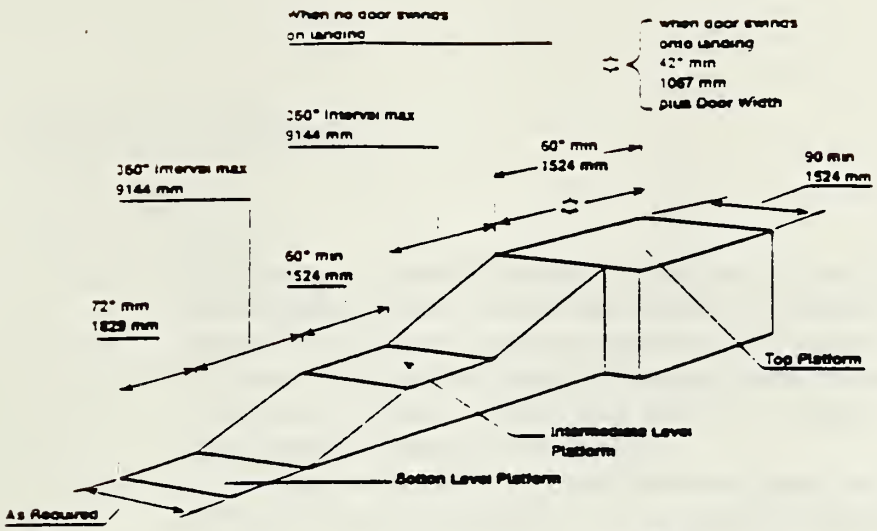
Ramp With Intermediate Switch-Back Platform

Note:
Maximum Horizontal Distances of each ramp and run varies. See table under 2-3308
All ramps must meet handrail and curb


24" min. (610 mm) clear and 18" min. (460 mm) beyond the arcs edge of a gate or door on the side toward which it swings.
Door width min 42" (1067 mm)
60" min. (1524 mm)

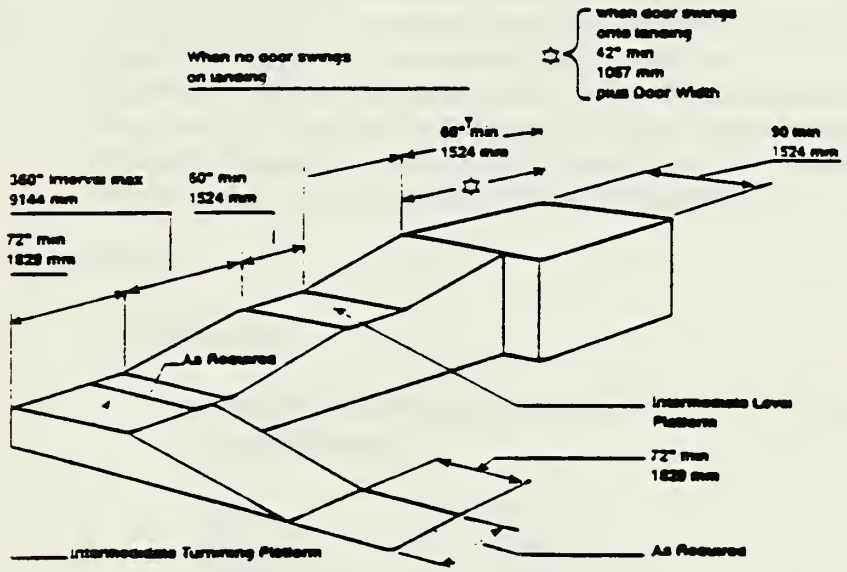
Ramp Landing At Doorway

Ramp Standards



Straight Ramp Run

Note:
Maximum Horizontal Distances of each ramp and run varies. See table under 2-3306



Ramp With Turning Platform

Note:
Maximum Horizontal Distances of each ramp and run varies. See table under 2-3306

Ramp Standards

3.3 QUEUING REQUIREMENTS

3.3.1 INTENT

a. To provide and maintain adequate space around ticket vending machines, and fare collection areas to ensure safe and efficient passage through the entry and exit and to ensure safe, secure areas for ticket purchasing.

b. To provide and maintain adequate distances at the top and bottom of all vertical circulation elements to ensure safe and easy circulation, as well as adequate clear space for emergency evacuation.

c. To provide and maintain adequate distances around all stationary elements to ensure clear, open pathways to the trains, platforms and circulation elements.

3.3.2 PRINCIPLES

a. Vertical circulation elements should be located as much as possible along the same line or lines to ensure clear, simple circulation patterns and minimize pedestrian intersections where cross traffic is created.

b. Vertical circulation elements should be stacked or grouped within the "grid quadrants" created by the structural support columns.

c. Ticketing machines should be located in an obvious location and close to the main entry to the station, but outside of the main circulation patterns.

d. Circulation should be a clear, sequential series of elements so that passengers are not required to double back or create cross traffic.

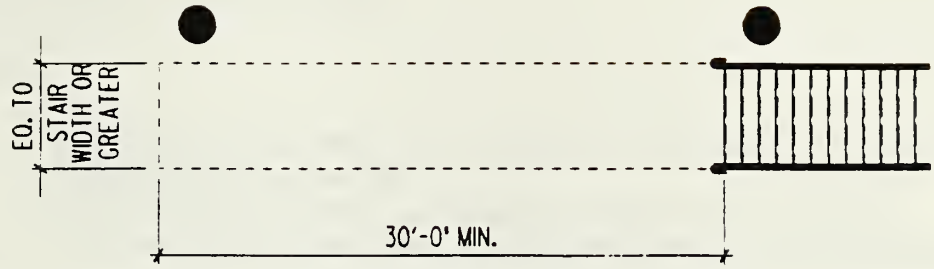
3.3.3 STANDARDS

a. Queuing space

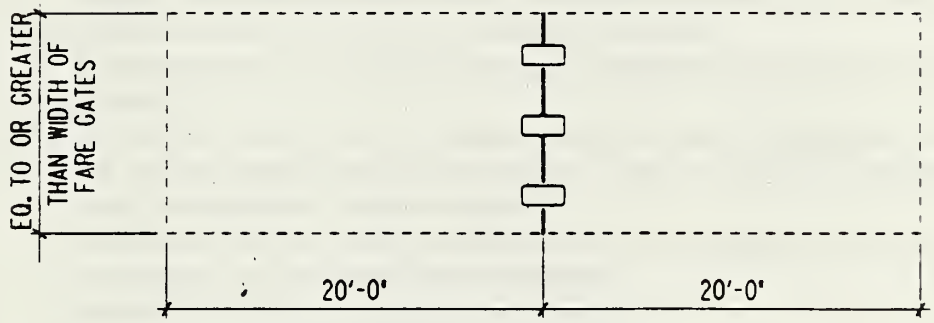
- Minimum recommended clear queuing distance at the top and/or bottom of each element:

Stairs	30'-0"
Elevators	10'-0"
Escalators	20'-0"
Ticketing Machines	8'-0"

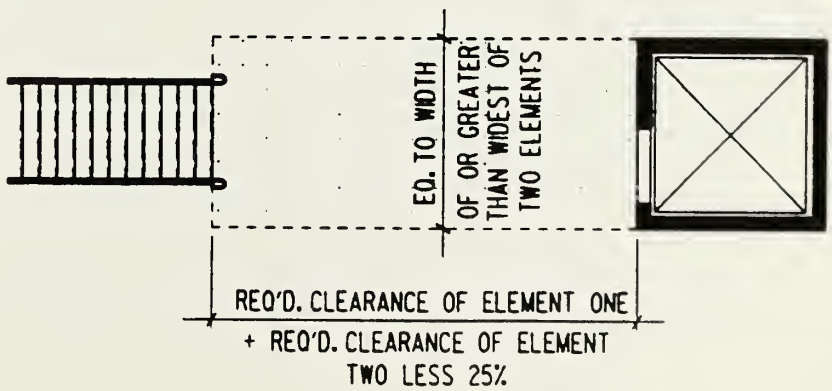
- Where elements are located facing each other (for example, a stair facing an escalator), the minimum clear queuing distance shall be the sum of the required queuing distances less 25% of that sum.



Queuing distance: Stairs



Queuing distance: Fare Gates



Queuing distance: Facing Elements

3.4 VEHICULAR ACCESS AND CIRCULATION

3.4.1 INTENT

a. To provide for the safety and convenience of patrons while arriving and departing from the station site.
b. To provide clear, convenient, and efficient vehicular circulation patterns.
c. To provide easy vehicular access to and departure from the station entrances.

3.4.2 PRINCIPLES

a. Vehicular circulation should relate to existing or planned traffic patterns and should be simple and direct.
b. Drop-off and loading areas should directly adjoin the main station entrance and be covered to provide protection from the weather.
c. Drop-off and loading activities should take place on a separate circulation roadway to provide for efficient and convenient operation of taxis, private autos and other demand responsive transportation services
d. A separate bus lane should be provided for efficient and convenient passenger transfers.
e. A short-term parking area for persons waiting to pick up passengers should be conveniently located close to the pick-up zone to allow good visibility of the station exit and permit easy re-circulation.
f. Provisions should be made for rideshare/carpool unloading to minimize impact upon transit and traffic operations in the area.
g. Emergency vehicle access should be provided.
h. Service vehicle access and loading areas should be provided.

4.0 Safety and Security

4.1 PUBLIC SAFETY

4.1.1 Intent

a. to provide for public safety
b. to deter crime and vandalism
c. to ensure efficient operation of the station and provide optimum service to patrons
d. to provide station supervision by utilizing automatic devices and remote control equipment

4.1.2 Principles

a. Station design should be open with long unbroken lines of sight. Recesses, hidden corners and areas with limited visibility should be eliminated wherever possible to minimize surveillance problems.
b. All station entrances should be capable of being secured at their outermost points.
c. Illumination levels shall be selected to maintain the level of security in and around stations.
d. Station supervision should be handled by remote control systems, closed circuit television, passenger assistance telephones and public address systems.
e. Equipment or surfaces accessible to the public such as fare machines, emergency or passenger assistance telephones should be of rugged vandal resistant design.

4.1.3 Standards

a. Safety and security standards should comply with the applicable codes referenced in Section 2.2 of this document.

5.0 Urban Design

This section forms the basis of a more comprehensive study that must take place as a part of the planning process of the station terminal. It is the intent here to outline the issues that delineate the overall physical form of development of the station terminal area and, through the application of these guidelines, assure a harmonious visual relationship between buildings, the immediate terminal station area and the overall Transbay area.

5.1 TERMINAL STATION PORTAL AND PUBLIC SPACES

5.1.1 INTENT

a. To provide a transit station environment that creates a sense of place and establishes an urban focal point for the Transbay area.
b. To provide a transit station environment that improves the pedestrian area by providing human-scale interest and activities at the street level.
c. To preserve existing building relationships and neighborhood character and support future joint development.
d. To integrate the station into the overall urban form and image of the Transbay area both aesthetically and environmentally.
e. Implementation of a public arts program should be an integral part of the urban design of the station area.

5.1.2 PRINCIPLES

a. The station portals should be readily identifiable within the area, easily distinguished from other transit system stations, well-lighted and inviting.
b. The station portal should be defined by an entry structure to provide identification and protection from the weather.
c. An arrival area should be located at the station entrances outside of but adjacent to the flow of traffic to provide a comfortable space for patron orientation, gathering and waiting.
d. Pedestrian walkways should be as open as possible and well-lighted, avoiding isolated passageways.

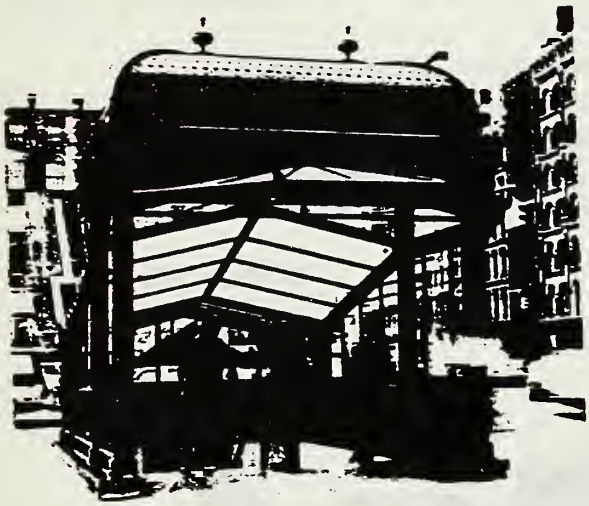
5.1.3 STANDARDS

a. Station portals shall contain a minimum of one escalator and one stair for vertical circulation and exiting.
b. A minimum of one elevator for disabled access to the mezzanine level at the underground station shall be provided within close alignment and proximity of the station portal.
c. Sidewalk widths of not less than 8 feet must be maintained to the adjacent property line.

d. Station ~~portal~~ entrances should be oriented parallel to pedestrian walkway flow or in such a manner so as to avoid conflicts with exiting patrons of the transit system.

e. Any Public Arts Program should comply with the guidelines established by the Public Arts Program of the City of San Francisco.

5.1.4 PRECEDENTS



5.2 TRAIN PORTAL

Train portals will occur whenever the train and trackway enter or leave a subway section to run at grade or along elevated sections. This will occur because the grade at which the train can operate differs from the existing terrain or where another fixed element (such as a roadway) must pass under or over the trackway.

5.2.1 INTENT

a. To ensure the impacts on the surrounding neighborhood of the train and trackway structures are minimized or mitigated to the best extent possible.
b. To ensure the safety and security of the general public as well as the passengers, employees and operators of the transit system.

5.2.2 PRINCIPLES

a. Provide landscape and other visual or acoustical buffers within the portal area.
b. Utilize architectural materials and treatments which help to provide a transition between the portal and the surrounding materials or structures.
c. Provide deterrents to climbing, walking on or over, hiding in or around the portal or vehicles driving into the portal and surrounding area.

5.2.4 PRECEDENTS

5.3 AMENITIES

5.3.1 INTENT

a. To provide an attractive, interesting and functional environment in and around the terminal station by including amenities such as attractive, safe and secure gathering and waiting areas, newsstands and convenience retail.

5.3.2 PRINCIPLES

a. Covered waiting areas should be provided in the arrival area. Provisions should be made for both information and concession kiosks at the main entrance to the station and located convenient to normal passenger flow both for entering and exiting passengers but should not obstruct pedestrian flow.

b. Concessions (if provided) should be a part of a total station design and should not be an element tacked on as an afterthought.

c. Retail uses should be encouraged at street levels adjacent to the station entrance zone.

d. Restroom facilities should be easily accessible and identifiable.

5.3.3 STANDARDS

a. Restrooms, drinking fountains and other amenities shall be located on the mezzanine level within easy visual access of the station control personnel.

b. All public facilities and amenities shall conform to ADAAG guidelines.

5.3.4 PRECEDENTS

5.4 STREETSCAPE DESIGN

Streetscape generally refers to all of the component parts that makeup the street environment. This includes elements in the public right of way (sidewalks, landscape, street furniture, etc.) as well as private areas that open onto the street such as arcades and plazas. In essence, streetscape includes all the physical elements which affect the senses of the users.

5.4.1 INTENT

a. To provide a streetscape design that is responsive to the terminal station portal architectural character and functions as a complementary design element within the overall urban design of the station and the Transbay area.

b. To provide a streetscape design that is aesthetically pleasing and environmentally responsive.

c. To provide a streetscape design that promotes safety and security.

5.4.2 PRINCIPLES

a. The streetscape design should be compatible with the overall transit system design .

b. Landscape materials and street furniture should be located so as to avoid encroaching on trackways and safety walkways.

c. Landscape materials and street furniture should be designed to promote safety and security for patrons, avoiding concealed places and blind corners.

d. Landscape materials and street furniture should not obstruct patron, vehicular or train operator views.

e. Landscape materials and street furniture should be used to identify entrances, exits, traffic routes, etc. whenever possible.

5.4.3 STANDARDS

a. Plant materials

- Plant materials should be compatible with local climactic conditions, conserve water resources, and require minimum initial cost and maintenance.
- Maintain a 45° cone of vision so as not to obstruct the view of the train operator, other vehicles, and pedestrians.
- **[Street trees by City of SF plan guidelines]**

b. Street furniture

- All street furniture to be easily maintainable and replaceable.
- Benches
- Trash receptacles
- Bike racks
- Vending kiosks
- Transit shelters
- Public phones
- Drinking fountains
- Newspaper stands

c. Paving

- Base color and texture creates a continuity throughout the area
- Special treatments used for crosswalks, entrances, exits, areas of special use or interest to delineate these areas.

5.4.4 PRECEDENTS

6.0 Signage and Graphics

6.1 INTENT

a. To guide passengers through the terminal station in an orderly, logical and uncomplicated sequence.
b. To orient patrons in the terminal station through the use of uniform design and placement of signs and graphics.
c. To ensure accessible facilities and elements are identified and clear paths of travel are maintained.

6.2 PRINCIPLES

a. Signs should be kept to a minimum necessary for passenger guidance, yet placed at frequent enough intervals so that patrons can find their way without assistance.
b. Architectural elements, landscape and other design elements should be used to identify entrances, exits, traffic routes, etc. without signs whenever possible.
c. The message on each sign or graphic should be bold,concise, clear and easily understood by a wide variety of patrons.
d. Signage identifying the terminal station in its urban surround should be bold and direct for both pedestrian and vehicular traffic.
e. Sign layout should be flexible to permit changes or additions to the legend to reflect changes in the terminal station.
f. CalTrain system signs and graphics should be clearly distinguished from other transit system signage.
g. Signage should be illuminated wherever necessary.
h. Audio and visual information systems and sound signaling should be used to assist a wide range of patrons including the disabled.

6.3 STANDARDS

a. ADA: Raised and Braille characters shall be provided at signs identifying station names, instructional signs, use of emergency phones, alarms, ticketing, public phones and drinking fountains.
b. Interior: Identification of vertical circulation, exiting, transportation connections, public facilities, ticketing and system information, and emergency information and instructions.
c. Exterior: System identification, vertical circulation, and transportation connections.
d. Audio-visual system, sound signaling: Provision of audible and visual warning systems in compliance with ADAAG and Title 24.
e. Content of signs:
   - directional
   - identification
   - regulatory
   - variable message
   - accessibility
   - informational
   - scheduling
   - fare information

6.4 PRECEDENTS

7.0 Lighting

7.1 INTENT

a. To provide security, safety and ease of movement.
b. To assist in path-finding.
c. To be integrated into the architecture of the station as a design element.

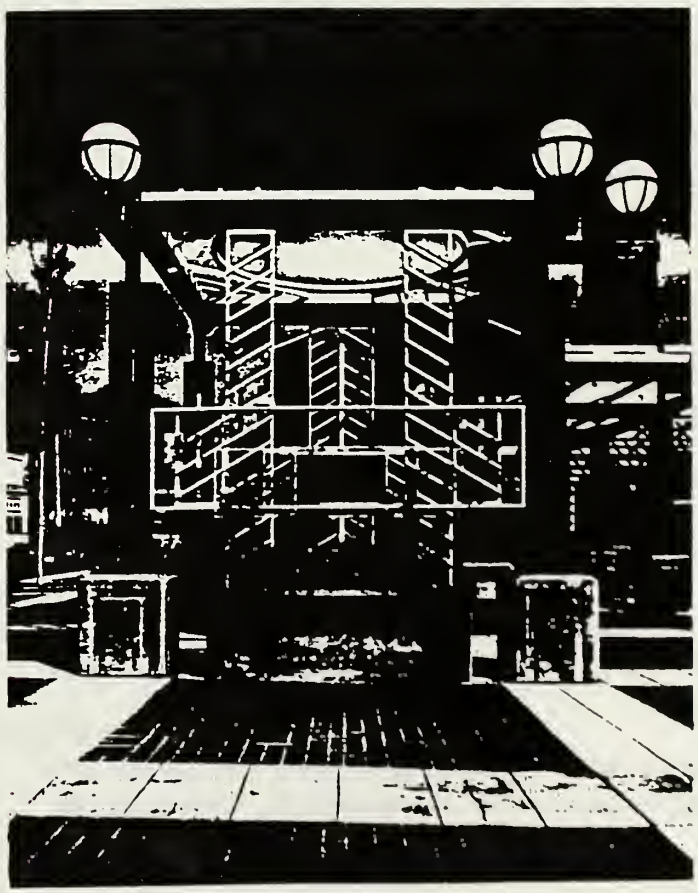
7.2 PRINCIPLES

a. Natural daylighting should be integrated into the terminal station wherever possible, especially at the mezzanine and platform levels.
b. Lighting in public areas should be high enough to ensure complete visibility and to provide a pleasant and secure atmosphere.
c. Lighting should be used as a design element to accentuate specific areas such as points of vertical circulation, waiting and concession areas.
d. Landscape lighting should encourage pedestrian orientation and security.

7.3 STANDARDS

a. Types: fluorescent, incandescent, HID
b. Low maintenance
c. Energy efficient

7.4 PRECEDENTS



8.0 Architectural Design

This section describes a basic set of guidelines toward establishing an architectural language for the CalTrain terminal station. The terminal station should be a significant piece of the urban fabric responding to its surroundings in an integrated, contextual manner, appropriate for its particular environment, and which helps to promote a positive passenger experience of the terminal station. The architectural character should be inviting, encouraging use of the facility, and should promote movement and activity through the use of intuitive and visual clues. At the same time, the architectural language should be based on a concept which utilizes economical, readily available, and easily maintained materials.

8.1 TERMINAL STATION

8.1.1 INTENT

a. To establish the terminal station as an architectural focal point for the Transbay area that is integrated into the character of existing and proposed development.
b. To promote harmony in the visual relationships and transition between new and older buildings.
c. To preserve the traditional street to building relationship that characterizes downtown San Francisco.

8.1.2 PRINCIPLES

a. Utilize materials and finishes with a durable, lasting quality.
b. Provide an architectural character which can help promote ease and comfort for the patrons of the transit system.
c. Comply with surrounding policy and neighborhood planning documents and strategies.

8.1.3 STANDARDS

a. Scale and massing
   - The scale and massing of the terminal station should relate to the scale and massing of existing structures in the surrounding area and to proposed future development.
   - Compliance with City of San Francisco Planning Code and Height and Bulk Massing Maps.

b. Setbacks
   - Compliance with City of San Francisco Planning
   - Code and Height and Bulk Massing Maps.

c. Building height
   - The height of the terminal station should relate to the height of existing structures in the surrounding area and to proposed future development

- Compliance with City of San Francisco Planning Code and Height and Bulk Massing Maps

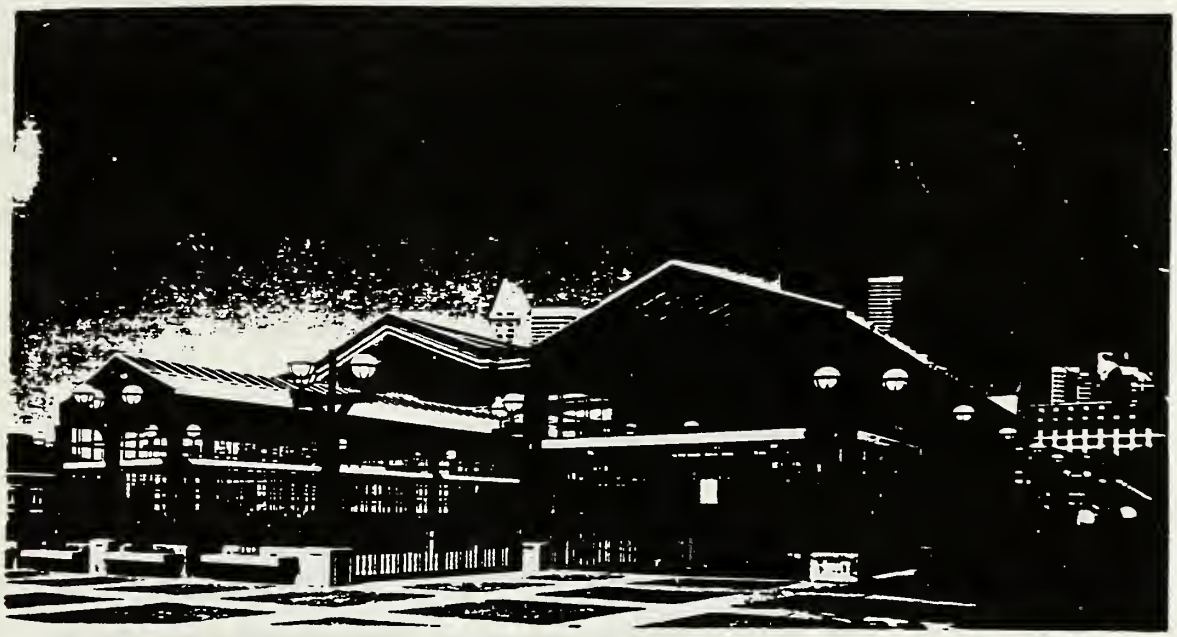
d. Special building elements
   - Vertical circulation elements should be integrated into the design of the terminal station as architectural elements.
   - Station ventilation stacks should be located to avoid major public areas and to interfere with adjacent uses. Where appropriate, ventilation structures should be integrated into the architectural design concepts for the station area and portals.
   - In all public areas, the minimum overhead clearance to obstructions shall be 11 feet above finish floor. However, at localized critical points such as portals, clearance may be reduced to not less than 9 feet.
   - Passageways shall maintain an overhead clear height of 16'-4".

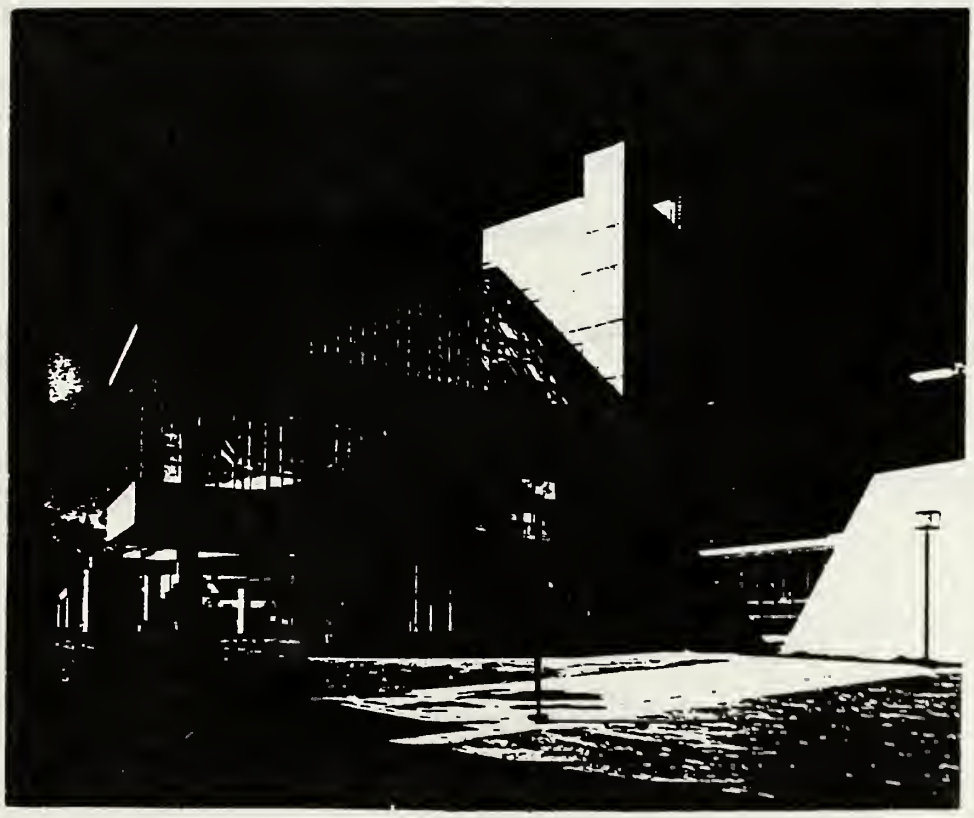
e. Materials and finishes
   - A range of appropriate materials and finishes should be defined to achieve a desired level of quality and cost.
   - All materials should maintain color, texture, and finish throughout their useful life and be durable and resistant to weather where necessary.
   - All materials and finishes should be readily available through conventional sources and easily replaceable.
   - All materials and finishes should be resistant to vandalism and graffiti and should not require special maintenance.
   - All materials and finishes should comply with the appropriate fire and safety codes.
   - Materials should consider acoustical and noise control properties whenever feasible to reduce noise from locomotives.
   - Maintain appropriate ADAAG slip resistance standards for finish materials.

f. Building Components and Amenities
   - Building components and amenities should be built-in and secured whenever possible to discourage theft and to reduce maintenance. Nooks, alcoves and other small hidden spaces should be avoided.
   - Any station element which could be targeted for vandalism, graffiti or theft (such as lighting, speakers, security cameras, etc.) shall be located a minimum of 9'-3" above any adjacent horizontal surface.
   - Any building component or amenity not essential to operations or for passenger entraining or detraining shall be located on the mezzanine level.
   - In addition to the primary architectural components listed previously and system operational requirements, building components and amenities which are anticipated at the station include:

- Benches
- Bicycle racks
- Trash receptacles
- Ticketing machines
- Doors and hardware
- Fire hose cabinets
- Electrical, storage and building maintenance rooms
- Emergency, maintenance and public telephones
- Drinking fountain
- Public toilets

8.1.4 PRECEDENTS





D. STRUCTURAL DESIGN CRITERIA

1.0 INTRODUCTION

This section covers the technical requirements for Structural Design. Since this criteria has been developed for the preparation of very preliminary plans, which will be used for a conceptual design-level capital cost estimate, the data given is basic. Structural methods and sizes have generally been established based on the experience of our structural engineers and geotechnical consultants. Items covered include elevated track structures, subway structures, stations, retaining walls, construction structures, and miscellaneous structures.

2.0 DESIGN CODES, MANUALS AND SPECIFICATIONS

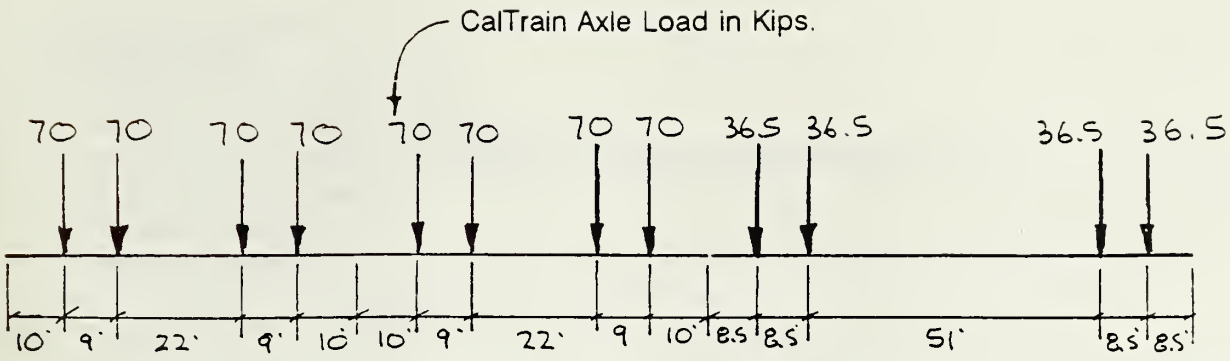
Structural design shall conform to the following codes, manuals, or specifications specified herein.

- Manual for Railway Engineering(AREA), American Railway Engineering Association.
- Bridge Design Specifications(BDS), California Department of Transportation.
- Building Code(BC), City and County of San Francisco.
- Uniform Building Code(UBC), International Conference of Building Officials.
- Building Code Requirements for Reinforced Concrete(ACI), American Concrete Institute.
- Manual of Steel Construction(AISC), American Institute of Steel Construction.
- Structural Welding Code(AWS), American Welding Society.
- Analysis and Design of Reinforced Concrete Guideway Structures, American Concrete Institute.
- Recommendations for Prestressed Rock and Soil Anchors, Post-Tensioning Institute.
- Design & Performance Criteria, Los Angeles Metropolitan Transit Authority, 1994. These are the most current criteria for transit and subway structures and include the most recent requirements for earthquake/seismic design.

3.0 TRAIN LOADS

Dead Loads(DL) - include the weights which are supported by the structures.

Train Loads(LL) - The weight of the locomotives plus passenger cars:



LIVE LOAD DIAGRAM
CalTrain Locomotives plus Passenger Cars

Vertical(VI) and Horizontal(HI) Impacts:

Vertical Impact=30%*(LL)
Horizontal Impact=10%*(LL)
The horizontal impact shall apply at 3.5 feet above the top of low rail.

Longitudinal Force(LF):

Emergency Braking Force=30%*(LL)
Normal Braking Force=15%*(LL)

Centrifugal Force(CF);

CF=V*V*(LL)/R/g
Where
V=maximum operational speed
R=radius of curvature
g=acceleration due to gravity.

Centrifugal force shall apply at 5 feet above the top of low rail.

4.0 ELEVATED TRACK STRUCTURES

All components of elevated structures shall be proportioned to withstand the following loads and forces:

4.1 DEAD LOADS(DL)

4.2 TRAIN LOADS(TL): As stipulated on Section 3.0.

4.3 OTHER LOADS: Other loads shall be in accordance with the AREA and BDS, except noted herein:

Earth Pressure(EP)
Buoyancy(B)
Wind Load on Structure(WI)
Wind Load on Train(WT): 400 plf
Earthquake Force(EQ): BDS Elastic Response Spectra with A=0.6
Concrete Shrinkage(S)
Rib Shortening(R)
Thermal Forces(T)

4.4 COMBINATIONS OF LOADS

Load combinations shall be in accordance with BDS, except that train loads shall be included in Group VII.

5.0 STATIONS AND BUILDINGS

The design of the stations and the buildings shall meet the requirements of the BC, UBC, ACI, AISC and AWS. In addition, for structures which support train loads, the design shall also meet the provisions of Section 4.0

6.0 CUT-AND-COVER AND TUNNEL STRUCTURES

All underground structures: cut-and-cover line and station, tunnels and tunnel supports, shafts, portals and U-sections, retaining walls, and temporary excavation structures shall be designed to meet the requirements of Design & Performance Criteria, Los Angeles Metropolitan Transit Authority, 1994.

E. VENTILATION DESIGN CRITERIA

1.0 OBJECTIVE

The purpose of this sub-task is to describe the functional and design requirements for the underground station and tunnels ventilation system for the approximate 1.5 mile CalTrain San Francisco Downtown Extension Project. The criteria are intended to promote understanding of the ventilation system's requirements, uniformity and consistency in regards to the type, location, operation and control of ventilation equipment.

The ventilation system design shall effectively interface with the design parameters set forth for other systems as appropriate.

The ventilation system design shall comply with the applicable local, state, and national code, and industry standards, insofar as practically possible.

2.0 GENERAL DISCUSSION

Three types of locomotives are proposed for the CalTrain San Francisco Downtown Extension project, in considering the emissions, costs and other factors.

1. Retrofit "clean" diesel powered locomotives
2. Retrofit Liquefied Natural Gas (LNG) powered locomotives
3. Electric powered locomotives (straight electric or dual-mode).

The electric locomotives are considered as non-pollution vehicles. The criteria related to emissions and emission dilutions are not applicable to them. For the two fossil-fuel powered locomotives, the feasibility and costs to dilute exhausts from the locomotives and maintain a proper environs in the station and tunnels will be one of the major considerations for the ventilation system design.

2.1 AIR QUALITY

2.1.1 Relevant Pollutants

Six air pollutants related to diesel and natural gas engine emissions have been identified by the U.S. Environmental Protection Agency (EPA) as being of concern nationwide: 1) carbon monoxide; 2) nitrogen dioxide; 3) ozone; 4) particulate matter; 5) sulfur dioxide and 6) lead. Diesel powered vehicles are also associated with organics and heavy metals emitted in trace quantities. In addition, some of these items are potentially odorous. However, diesel engine-related air pollutants which are emitted in significant quantities, and for which emissions factors are known and standards exist, include carbon monoxide (CO), nitrogen oxides (NO_x) and formaldehyde (HCHO).

(1) Carbon monoxide (CO) is a colorless and odorless gas, which is associated primarily with the incomplete combustion of fossil fuels in motor vehicles. Carbon monoxide concentrations can vary greatly over comparatively short distances. Relatively high concentrations are typically found near crowded intersections, along heavily used roadways carrying slow-moving traffic, and at or near ground level. Even under the severest meteorological and traffic conditions, high concentrations of carbon monoxide are limited to locations within a relatively short distance (300 to 600 feet) of heavily traveled roadways. Overall carbon

monoxide emissions are decreasing as a result of the Federal Motor Vehicle Control Program. which has mandated increasingly lower emission levels for vehicles manufactured since 1973.

(2) Nitrogen dioxide (NO_2) is a gas produced when nitric oxide (NO) combines with oxygen in the atmosphere. The nitric oxide for the reaction is produced during the high temperature combustion of fossil fuels in electric power generating facilities, industrial operations, automobiles and chemical processing plants.

(3) Ozone (O_3) is the principal component of photochemical smog. It is formed in the atmosphere through a series of reactions involving volatile organic compounds (VOCs), such as gasoline and diesel fumes, oil-based paints and nitrogen oxides in the presence of sunlight. Significant ozone concentrations are normally produced only in the summer, when insolation is greatest and temperatures are high. VOC levels are considered the critical and limiting factor in ozone formation; control strategies for ozone focus on reducing VOC emissions.

(4) Particulate Matter (PM-10) includes both liquid and solid particles of a wide range of sizes and composition. Of particular concern are those particles which are smaller than or equal to 10 microns in size (PM-10). The principle health effect of air-borne particulate matter is on the respiratory system. Diesel engines have traditionally been the largest mobile source contributors to PM-10 levels.

(5) Sulfur Dioxide (SO_2) is a gaseous compound of sulfur and oxygen produced primarily from the burning of fossil fuels containing sulfur compounds. Sulfur dioxide can be transformed into other products such as fine particulate sulfates and sulfuric acid mist.

(6) Lead (Pb) is a stable compound which persists and accumulates both in the environment and in animals. The lead in gasoline anti-knock additives represented a major fraction of total U.S. lead consumption until recently. Motor vehicle emissions constitute a major source of lead emissions to the atmosphere. Since no lead additives are used in diesel and LNG fuels for locomotives, the analysis for lead emissions does not apply for this study.

2.1.2 National and State Ambient Air Quality Standards

As required by the Clean Air Act Amendments, National Ambient Air Quality Standards (NAAQS) have been established for the six major pollutants. Hydrocarbon standards, which had been promulgated, have been rescinded because these pollutants are primarily of concern only in their role as ozone precursors. These national standards are listed in Table 1. The "primary" standards have been established to protect the public health with an adequate margin of safety. The "secondary" standards are intended to protect the nation's welfare and account for air-pollutant effects in soil, water, visibility, materials, vegetation and other aspects of the general welfare.

The Clean Air Resources Board (ARB) of the California Environmental Protection Agency (CAL/EPA) established more stringent State Ambient Air Quality Standards (SAAQS, Table 2). To monitor and control the ambient air quality, ARB divided the state into many "air basins". Table 3 lists the average peak-day concentrations for the City of San Francisco in 1991 - 1993.

As shown, the concentrations of all air pollutants in the City of San Francisco are currently below the limits required by SAAQS, except for PM_{10}. The existing ambient concentrations for the study are those shown in Table 3 (expected peak day limits).

TABLE 1 NATIONAL AMBIENT AIR QUALITY STANDARDS
(all concentrations in $\mu g/m^3$ unless otherwise noted)

Contaminant	Averaging Period	Primary Standard	Secondary Standard
1. Carbon Monoxide (CO)	8-hour (a) 1-hour (a)	10,000 (9 ppm) 40,000 (35 ppm)	-- --
2. Nitrogen Dioxide (NO_2)	Annual	100 (0.05 ppm)	100
3. Ozone (O_3)[(b)]	1-hour	235 (0.12 ppm)	235
4. Particulate Matter (PM-10)	Annual 24-hour	50 150	50 150
5. Sulfur Dioxide (SO_2)	Annual 24-hour (a) 3-hour (a)	80 (0.03 ppm) 365 (0.14 ppm)	-- -- 1,300 (0.5 ppm)
6. Lead (Pb)	3-month (calendar quarter)	1.5	1.5

Source: U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards", (49 CFR 50).

(a) Not to be exceeded more than twice in a two-year period per site.

(b) The number of days with hourly levels greater than standard are not to be exceeded more than three times in a three-year period.

(ppm) = parts per million, (μg) = micrograms

TABLE 2 CALIFORNIA STATE AMBIENT AIR QUALITY STANDARDS
(all concentrations in $\mu g/m^3$ unless otherwise noted)

Contaminant	Averaging Period	Primary Standard
1. Carbon Monoxide (CO)	8-hour (a) 1-hour (a)	10,000 (9 ppm) 23,000 (20 ppm)
2. Nitrogen Dioxide (NO_2)	1-hour	470 (0.25 ppm)
3. Ozone (O_3)	1-hour	180 (0.09 ppm)
4. Particulate Matter (PM-10)	Annual 24-hour	30 50
5. Sulfur Dioxide (SO_2)	24-hour 1-hour	25 0.25
6. Lead (Pb)	30-day	1.5

Source: *State of California Air Resources Board Ambient Air Quality Standards, Dec., 1994*

TABLE 3

Average Concentrations for the City of San Francisco
1991 - 1993

Contaminant	Time Period (hrs)	EPDC* (ppm)	State Standard (ppm)
1. Carbon Monoxide (CO)	8	6.17	9
2. Nitrogen Dioxide (NO_2)	1	0.0988	0.25
3. Ozone (O_3)	1	0.0539	0.09
4. Particulate Matter (PM-10)	24	97.63 $\mu g/m^3$	50 $\mu g/m^3$
5. Sulfur Dioxide (SO_2)	1	0.0355	0.25
6. Lead (Pb)	30 days	-	1.5

Source: *State of California Air Resources Board Ambient Air Quality Standards, Attachment E, Dec., 1994*

* *Expected Peak Day Concentrations*

2.2 VENTILATION SYSTEM REQUIREMENTS

There are four main issues to be addressed by the CalTrain passenger station and tunnel ventilation system when diesel and LNG-powered locomotives are proposed:

- emissions from the locomotives' fossil fuel-burning engines;
- acceptable environmental conditions for patrons and workers while in the station and in tunnel environs (heat, smoke and odor);
- control of smoke and heat in case of a fire in the tunnels or at the station;
- control of fan discharges into the ambient (air above ground).

2.2.1 Emissions

The emission concentrations design criteria selected for designing the ventilation system are based on assumptions that the patron will be in the station for only a short period of time; thus, the Short Term Exposure Limit (STEL) (15-minute) value will apply to them. The CalTrain workers in the station will be in their local environment (station control booth) and will not be exposed to the station environment for extensive periods of time. When there will be workers doing maintenance in the tunnels, the 8-hour Permissible Exposure Limit (PEL) value will be used as criteria. Thus, it is more stringent than that for the station. Different fan operation modes are needed for this situation.

Carbon Monoxide. The effects of CO on an individual depend on a number of factors including: (1) the amount of CO absorbed by the bloodstream, (2) the exposure time, (3) the level of physical activity, and (4) the altitude above sea level.

CO is an asphyxiant, meaning that it combines readily with the hemoglobin in the blood and thus decreases the blood's oxygen-carrying capability. The severity of the symptoms experienced by a person increases with the percentage of hemoglobin that has absorbed CO (carboxyhemo-globin or COHb). Literature shows that a person can tolerate a 10 percent COHb level without noticeable effects.

After breathing non-toxic concentrations of CO for several hours, a COHb equilibrium level is reached. This equilibrium value depends on the CO concentration of the surrounding air. For example, exposure to 100 parts per million (ppm) long enough to reach equilibrium would result in a COHb equilibrium level of 18 percent (at sea level).

The current "Barclays California Code of Regulation" of California Occupational Safety and Health Administration (CAL/OSHA) sets the CO PEL to be 25 ppm, and with a maximum ceiling of 200 ppm not to be exceeded at any time. No STEL is given. For tunnel ventilation design, the EPA recommends a design CO concentration of 120 ppm for a 15-minute exposure (ASHRAE).

In addition to the locomotive emission rates and based on a review of the ambient air quality data, an ambient CO value of 7.0 ppm (from Table 3 and rounded up) is used as the initial value at the portal of the tunnel. It is assumed that some degree of mechanical ventilation will be kept on all the time during normal train operating hours. Emissions in both inbound and outbound tunnels as well as in the station will be exhausted by the station fans.

Ventilation rates for CO control will be based on diluting the CO produced by diesel or LNG locomotives to a maximum concentration of 120 ppm in the station. The concentrations will be checked against PEL value for maintenance workers.

Oxides of Nitrogen. Oxides of nitrogen is primarily composed of nitric oxide and nitrogen dioxide. CAL/OSHA establishes a PEL of 25 ppm for NO and a STEL of 1 ppm for nitrogen dioxide. It is generally assumed that they exist in a 3:1 ratio in vehicle tunnels and the conversion rate (NO to NO_2) is typically 5 to 10% for short tunnels (up to 3000 feet) and as much as 20% (which will be used in this study) for longer tunnels.

Although CAL/OSHA made its standard more stringent as STEL of 1 ppm for NO_2, passengers will perceive the odor of diesel fumes at much lower concentrations. Passengers may find the diesel odor objectionable and complain, even though the concentration of NO_2 may be well below the CAL/OSHA limit. Therefore, while the selection of a criterion of 1 ppm NO_2 may prevent passengers and workers from overexposure to a toxic gas, it may not prevent overexposure to passenger and worker odor complaints from either source. Odor perception is immediate at 0.42 ppm and can be perceived by some people at levels as low as 0.12 ppm (1995 ASHRAE).

Ventilation rates for NO and NO_2 control were based on diluting the NO and NO_2 produced by the locomotives to a maximum concentration of 25 ppm and 1.0 ppm, respectively, which would occur at the station. The concentrations will be checked against PEL value for maintenance workers.

Sulfur Dioxide. CAL/OSHA establishes a PEL of 2 ppm and a STEL of 5 ppm for this pollutant. Ventilation rates for SO_2 control will be based on diluting to a maximum 5 ppm, which would occur at the station. The SO_2 concentrations will be checked against PEL value for maintenance workers.

Ozone. CAL/OSHA establishes a PEL of 0.1 ppm and a STEL of 0.3 ppm for this pollutant. Ventilation rates for O_3 control will be based on diluting ozone to a maximum 0.3 ppm, which would occur at the station. The ozone concentrations will be checked against the PEL value for maintenance workers.

PM_{10}. CAL/OSHA establishes a PEL of 10 mg/m^3 for inert or nuisance dusts. Therefore, ventilation rates for PM_{10} control will be based on diluting PM_{10} to a maximum 10 mg/m^3, which would occur both in the station and in the tunnel.

Carbon Dioxide. Although the CO_2 is not part of EPA's concern, it is a special concern for transit subway systems. A symptom of high CO_2 concentration is drowsiness. CAL/OSHA establishes a PEL of 5,000 ppm (8-hour) and a STEL of 30,000 ppm (15-minute). Ventilation rates for CO_2 control will be based on diluting CO_2 to a maximum of 30,000 ppm, which would occur at the station. The concentrations in the tunnels will be checked against the PEL value for maintenance workers.

2.2.2 Visibility (Haze)

The exhaust emissions, principally from diesel-powered vehicles, can severely limit visibility within a tunnel and station area. Visibility can be measured in terms of the amount that a beam of light is attenuated over a given distance. The amount of attenuation is given in terms of an "extinction coefficient" (SEDH) or "attenuation coefficient" (ASHRAE). The Subway Environmental Design Handbook states that patrons become aware of reduced visibility when they cannot distinguish objects at the far end of a station. Therefore, the nuisance factor associated with reduced visibility is limited to short distances, say a station length. An extinction coefficient smaller than 0.002 per ft produces a visibility limit for dark objects at 2000 ft away but does not cause haze normally noticeable to patrons in stations up to 800 ft. Since

the length of the SF downtown CalTrain station would be 1000 ft, the required extinction coefficient is equal to, or less than 0.0016.

2.2.3 Environmental Conditions

The patrons should not be exposed to excessive temperatures and air velocities while accessing the station platforms, waiting or exiting. Current NFPA Standard 130 recommends a maximum air velocity not greater than 1,000 feet per minute (an average of 700 fpm is desirable). As for the temperature, while there are no firm criteria, a maximum 9 degrees F (5^{o}C) above the ambient (outside) temperature is recommended.

2.2.4 Smoke and Heat Spread Control

In addition to ventilation for the control of emissions, smoke and heat must be controlled in the event of a tunnel fire. The hot buoyant gases and smoke produced by a fire tend to collect in a hot layer along the crown of the tunnel. In the absence of forced ventilation, this hot smoke layer flows away from the site of the fire in both directions, while the air supporting combustion moves toward the fire and beneath the smoke layer. Small and full scale tests indicate that for a given fire heat release rate, tunnel cross-section and grade, there is a minimum longitudinal air velocity required to prevent the smoke layer from flowing back against the ventilating air stream (called "backlayering"). Because of buoyancy effects, the air velocity required to prevent smoke from flowing uphill increases with increasing tunnel grades.

Theoretical investigations of the backlayering phenomenon have used the criteria, which state that if the velocity of the airflow impinging on the fire site is kept above a certain value, then backlayering will not occur. This value, in feet per minute, is defined as the "*Critical Velocity*" and is calculated based on the vehicle Heat Release Rate (Btu/Hr), tunnel geometry (area, height), grade, and ambient conditions.

In case of a tunnel fire, sufficient mechanical ventilation should be provided to move smoke in one direction, as required to maintain acceptable conditions along a single evacuation path from one side of the fire. Acceptable evacuation conditions, in case of a fire, are defined as follows:

- maximum temperature in the evacuation route shall be 140 ^{o}F or less (ignoring the radiating heat);
- minimum air velocity in the evacuation path shall not be less than the "Critical Velocity" required to control the backlayering of smoke and fire products in the evacuation path.

2.3 NOISE

Community noise levels in urban areas usually range between 45 and 85 dBA, 45 dBA being the daytime level in a typical quiet living room, and 85 dBA being the approximate level near the sidewalk adjacent to heavy traffic. For reference and orientation to the decibel scale, representative environmental noises and their respective dBA levels are shown in Table 4.

Table 4
Common Noise Levels

Sound Source	Noise Level (dBA)	Apparent Loudness	Typical Reaction
Highway traffic at 15 meters, or busy city street, or loud shout	70	Base reference	Telephone use difficult
Busy traffic intersection	80	2 times as loud	Annoying
Freight train at 15 meters	95	4-5 times as loud	Very annoying/hearing damage

3.0 DESIGN SCENARIO

The design scenario represents the expected heaviest loading on the ventilation system and forms the basis for the design of all major items of machinery and equipment required. The critical parameters of the design scenario are: the tunnel geometry and grade; horsepower, type and location of the locomotive units; the speeds that can be achieved with the specified train; dwell time; and train patronage.

Cooling air is required to ensure that the air temperature at the locomotive radiator air intakes does not exceed the critical value (approximately 118°F). Above the critical temperature, the engine starts to overheat and will eventually notch back to a lower throttle setting or shut down. Available test data indicates that the temperature distribution will be highly stratified in the tunnel, and it may be appropriate to use locomotives especially modified for tunnel operation. These modified locomotives would draw in radiator cooling air at a lower elevation than standard locomotives, permitting operation in a higher average tunnel air temperature environment.

Adequate air quality prior to the entry of a train into the tunnel is maintained by the use of flushing fans. The air quality determination is a complex problem requiring consideration of the following operating scenarios:

(1) Normal Operation Conditions

The ventilation system is required for the removal of diesel or LNG locomotive exhaust fumes and the elimination of stale odors, which are gases denser than air.

(a) Air quality for the crew in the locomotive or cab car;

(b) Air quality for the crew in the rear locomotive (push-pull operations);

(c) Air quality for patrons on the station platforms;

(d) Air quality for operating and maintenance personnel working in both the station and tunnels.

(2) Breakdown, Maintenance and Emergency Conditions

(a) Prevent long-term corrosion problems;

(b) Maintenance - air quality for wayside workers;

(c) Train breakdown;

(d) Fire - for evacuation of passengers and crews and to assist in the fire fighting.

The design scenario currently specified for the CalTrain San Francisco Downtown Extension Project is as follows:

(a) The underground station will be dead-ended, with two track-levels and center platforms.

(b) Power will be provided by up to two (2) diesel or LNG locomotive units, which will always be located at the south end of the train pointing towards San Jose.

(c) The units will be 3200 h.p., model F40PH-2 locomotives modified for tunnel use (principally by lowering the level of the radiator air intake).

(d) Each train will consist of a maximum of ten (10) cars, resulting in a maximum train length of 962.5 feet (2 x 56'-3" + 10 x 85').

(e) A maximum of ten (10) trains per hour in each direction will be considered.

(f) The ventilation system should be capable of accommodating a maximum of four (4) trains dwelling simultaneously for up to 15 minutes during the peak hours.

(g) Short (five-car) trains powered by a single locomotive will be run during off-peak hours. Such short trains can be stopped either centered (one per track), or two trains nose-to-tail on the same platform side (i.e., three locomotive positions possible).

(h) Normal operation will give priority to inbound trains in the morning and to outbound trains in the afternoon-evening rush hours.

(i) The ventilation system should satisfy a number of additional situations which will require special operating procedures:

- trains making unscheduled stops in the tunnels;
- single or multiple unit locomotives deadheading - i.e., without passenger cars;
- standard locomotives requiring more cooling than those with tunnel modifications;
- emergency or fire situations in which the use of fans is required for evacuation and fire-fighting;
- maintenance operations requiring the use of the permanent ventilation system.

The inlet air temperature to the locomotive radiators is used to judge the adequacy of the ventilation system when a train is in the tunnel. For a well-tuned engine with the air side of the radiators plugged 10%, the maximum allowable inlet air temperature for an F40PH-2 unit is given below. To account for a less than well-tuned engine and/or the air side of the radiators plugged more than 10%, a design goal for air inlet temperature is proposed, without substantially increasing the capacity of the ventilation system, as shown below:

Throttle	Maximum Air Inlet Temperature		Design Goal Air Inlet Temperature	
6	54.4°C	130°CF	48.9°C	122°F
7	48.9°C	122°F	43.3°C	110°F
8	47.8°C	118°CF	42.2°C	108°CF

The inlet air temperature to the locomotive radiators must be maintained at or below a fixed temperature. During peak traffic periods, the fans are required to cycle (cool-off, purge-off, cool-purge) over a train headway. Because the size of the fan motors precludes their frequent starts, air-cooled eddy current clutches are used for engaging and disengaging the fans from their continuously running motors during peak operating periods. The clutches are also used to vary the speed of the fans to satisfy the different performance requirements for cooling and purge.

4.0 DESIGN CRITERIA SUMMARY

4.1 EMISSIONS

Based on industry standards and current CAL/OSHA regulations, the following threshold emission limits will be allowed in the CalTrain San Francisco Downtown underground station:

- Carbon Monoxide (CO): 120 ppm (STEL) in station, 25 ppm in tunnel and station (PEL, only during maintenance)
- Nitrogen Oxides:
  NO ----- 25 ppm for 8-hour exposure (no STEL limit defined);
  NO_2 ----- 1 ppm for 15-minute exposure (no PEL limit defined).
- Particulate Matter (PM_{10}): 10 mg/m^3 (SEDH, confirmed verbally by CAL/OSHA).
- Visibility (Haze): 0.0016 per ft (calculated from SEDH).
- Sulfur Dioxide (SO_2): 5 ppm in station (STEL), 2 ppm in tunnel and station (PEL, during maintenance)

4.2 OTHER REQUIREMENTS FOR SUBWAY ENVIRONMENT

In addition to meeting the above emission requirements, the ventilation system shall meet the following design criteria:

A. Temperature: To ensure an adequate supply of cooling air to the locomotives and to maintain acceptable air quality in the tunnels and in station under normal conditions, maximum air temperature shall be maintained at or below 105°F.

B. Fan discharge velocity is not to exceed 1000 fpm at street level, or 500 fpm on sidewalk (SEDH). If exhaust stacks will be used, the discharge velocity should be high enough to disperse contaminates into the atmosphere. A minimum of 2000 fpm is usually necessary (1995 ASHRAE). Per the Bay Area Air Quality Management District's Regulation 6, it should not emit from any source for a period or periods aggregating more than three minutes in any one-hour an emission equal to, or greater than 20% opacity as perceived by an opacity sensing device, where such device is required by District regulations. Also, It should not emit from any source particulate matter in excess of 343 mg per dry standard cubic meter (dscm) of exhaust gas volume.

C. Air Changes: In order to maintain the air qualities, the ventilation system shall be sized to provide a minimum of 15 minute air changes throughout the covered trackway (or 4 air changes per hour, SEDH). To prevent accumulation of offensive human odors, fresh air should be supplied at a minimum rate of 5 cfm per person (SEDH).

For preliminary design purposes, a nominal flush time of 5 minutes will be used as the initial design criteria for both inbound and outbound trains. The impact of this key design parameter will be reviewed in terms of the system operation by calculating train passage and ventilation flushing cycle times for various scenarios. The review involves the application of special computer techniques (Subway Environment Simulation - SES, TUNVEN, MOBILE5, etc).

Note that the federal and state ambient air quality standards, which are based on an individual's 24-hour health and welfare, are applicable only to the outside ambient. CAL/OSHA standards for a short-term exposure (15 minutes) or for an 8-hour exposure without sickness, irritation, etc. are applicable for patrons in station areas, and maintenance workers in station and tunnel areas, respectively. It is assumed that station attendants will work in separately ventilated rooms (eg., station control booth).

4.3 VENTILATION SYSTEM

4.3.1 Fan Type

4.3.1.1 Fans will be designed to operate in an ambient temperature of 482^{o}F for at least one (1) hour.

4.3.1.2 Ventilation fans will be of the axial-flow type with an internally-mounted, direct-drive motor, if possible. The fans will be selected to provide as high a total efficiency as possible, with the supply air flow capacity optimized. The choice of a vaneaxial flow, adjustable pitch, propeller-type fan, two-stage and reversible, as opposed to a centrifugal fan is largely dictated by the volume of air and the operating pressures plus the other features.

4.3.1.3 Fans will be reversible, and will be controlled in all modes both at the Central Control Center and the fan plant/local control; the local control will be capable of overriding the Central Control Center. The reversible feature was considered necessary to control the flow of air in the tunnel in the event of a possible fire.

4.3.1.4 Fans will have manually adjustable-pitch blades to permit a change in pressure versus air flow capacity for either system balancing or for future system modification. The adjustable pitch feature provides the flexibility needed to match fan performance with motor performance as dictated by actual operating conditions. Since there will be two fans, the failure of one will affect the operation by increasing the time for the flushing period, a condition which can be tolerated for a short period.

4.3.1.5 Local controls will be isolated to the extent possible from the path of exhausting products of combustion. Local control panels will be located in an environmentally protected installation (metal NEMA 4x); controls will be locked to prevent unauthorized use.

4.3.1.6 Conditions that will be annunciated at the Central Control Center will include:

1) all modes of operation;

2) damper operation, position, and fail-safe verification;

3) local control being in command of the fan operation; and

4) a failure/malfunction that prevents the Central Control Center from exercising command.

4.3.1.7 Fans will be fed from two separate feeders emanating from different services/electrical rooms.

4.3.2 Damper Design

4.3.2.1 Dampers will be heavy-duty, industrial, parallel-blade type, designed to withstand an ambient temperature of 482^{o}F for a minimum of one hour.

4.3.2.2 Dampers will be designed to withstand the reversible loads created by the piston effect of moving trains.

4.3.2.3 Fan dampers will be interlocked with the fans and will open when their respective fan is started. The "fail-safe" or "power-off" mode for damper positions will be "open" for fan dampers. The "fail-safe" or "power-off" mode for dampers at blast shafts will be based on computer simulation results.

4.3.2.4 Dampers and their associated structural supporting members shall be capable of withstanding a maximum differential static pressure of 16 inches water gauge; and minimum differential static pressure of 6 inches water gauge for two million reversals.

4.3.2.5 Each damper module will have two end switches. On end switch will indicate the fully open position and the other end switch will indicate the fully closed position.

4.3.3 Fan Operation and System Control

It is always desired that the capacity of the ventilation system be capable of satisfying all conditions:

1) normal operation;

2) congested operation;

3) maintenance operation; and

4) emergency (fire) condition.

Multiple units are beneficial when there are differences between required fan capacities for various conditions. Alternatively, two-speed fan motors could provide low- and high-flow capacity, as required.

The fans should be designed and installed with possibilities to be activated locally or remotely. Normally, a fan operation schedule should be developed in conjunction with the fire-life-safety evacuation plan in case of a tunnel or station fire. Any available dampers, louvers, fire doors, etc. should be tied-in with the fan operation.

The fan operation mode shall maintain the station entrances free of diesel or LNG locomotive exhaust gases and preferably in fresh (intake) air.

Specific design criteria for fan system control follow:

4.3.3.1 Control. The primary control of the ventilation equipment shall be from a Central Control Center which will have the capability to control all operating modes of tunnel and station ventilation fans and dampers.

4.3.3.2 Operational Scenarios. Train location(s), fire location (including on-board the train itself), and passenger evacuation routes are the three main factors that will affect the operation mode (supply or exhaust) of each of the tunnel and station ventilation fans. Based on these three parameters, operational scenarios will be developed for execution at the Central Control Center.

4.3.4 Noise and Vibration Control

Due to project location, operation of fans during regular work hours for normal and congested conditions will require the installation of sound attenuators (silencers). Generally, sound attenuators are not required for emergency fan operation, as this is incidental and does not require extensive running times. The design of sound attenuators will be based on the Dynamic Insertion Loss (DIL) levels to be provided by fan manufacturers. The feasibility of sound lining as required on fan rooms and vent shaft walls to limit noise levels shall be examined during the design phase.

Specially reinforced concrete foundations to prevent vibration (with housekeeping pads) are required. In sensitive locations, equipment which produces vibrations shall be isolated in accordance with ASHRAE Systems and Applications Handbook, Vibration Control Chapter.

4.3.5 Fan Discharge

There are no special regulations for subway ventilation discharges. The CAL/EPA and Bay Area Air Quality Management District have been contacted. Since there is no special regulation for this type of application, it appears that no permit is needed. District Regulation 6 for "point source" will be used as a guideline.

4.3.6 Special Condition

Since an underground passageway will connect the new CalTrain station to the existing BART/Muni Metro Embarcadero Station, the ventilation system shall prevent any possible air pollution contamination of the latter.

4.4 DESIGN MANUAL

A Design Manual for station and trackway ventilation should be prepared before proceeding with the design, equipment procurement and installation.

5.0 VENTILATION ANALYSES

The conceptual design of the CalTrain San Francisco Downtown Extension Project examines various alternatives of track alignment, station location and configuration, as well as different locomotive types. While the ventilation design criteria will stay the same, the analyses will depend on the configuration and equipment to be used.

Following is a matrix of ventilation analyses to be conducted for various conditions:

	Key Questions	Locomotive Propulsion Technology Option		
		Diesel	LNG	Electric
1	Normal Operating Conditions: - Human health, safety and community acceptance	emissions, air velocity, temperature	emissions, air velocity, temperature	air velocity, temperature
2	Emergency (Fire) Operating Conditions	one-car fire, critical air velocity, evacuation path	one-car fire, critical air velocity, evacuation path	one-car fire, critical air velocity, evacuation path
3	Functional Design and Performance Requirements	X	X	X
4	Conceptual Design of Required Equipment and Facilities (for cost estimating basis)	X	X	X

6.0 VENTILATION SYSTEM DESIGN REFERENCES (CODES, STANDARDS AND PUBLICATIONS):

Air Moving and Conditioning Association, Inc. (AMCA):

AMCA Standard 210, "Laboratory Methods of Testing Fans for Rating".
AMCA Standard 300, "Test Code for Sound Rating of Air Moving Devices".
AMCA Standard 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data".
AMCA Standard 500, "Test Method for Louvers, Dampers and Shutters".

American National Standards Institute (ANSI)

American Public Transit Association (APTA): Rapid Transit Design Guidelines.

American Society for Testing and Materials (ASTM)

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

Handbook of Equipment;
Handbook of Fundamentals:
Handbook of Systems and Applications.

American Society of Mechanical Engineers (ASME)

California Environmental Law Handbook

National Fire Protection Association (NFPA):

National Fire Codes;
NFPA Standard 130, Fixed Guideway Transit Systems;
NFPA Standard 70.

State of California, Department of Industrial Relations,
Division of Occupational Safety and Health (CAL/OSHA)

Underwriters Laboratories, Inc. (UL)

U.S. Department of Transportation:

Subway Environmental Design Handbook, Volume 1, "Principles and Applications", NTIS 254788, 1980.

Bay Area Air Quality Management District, Regulation 6.

APPENDIX A

CALIFORNIA BUILDING STANDARDS COMMISSION

1995 ANNUAL CODE ADOPTION CYCLE

MONOGRAPH

OF

CODE CHANGE SUBMITTALS FOR 1995
and
CODE ADVISORY COMMITTEE RECOMMENDATIONS

SUGGESTED REVISIONS
TO THE
CALIFORNIA BUILDING STANDARDS CODE

NOTE: Last day comments/challenges to this document will be accepted is September 20 ,1995 until 5 p.m.

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August 1995

ITEM 6 **As Submitted**
SFM 8/95
CHAPTER 3, SECTION 303
CHAPTER 4, SECTIONS 414A-414A.5.4
Amend California Building Code as follows:

CHAPTER 3
REQUIREMENTS FOR GROUP A OCCUPANCIES

SECTION 303 – REQUIREMENTS FOR GROUP A OCCUPANCIES

303.1 General.
303.1.1...
303.1.2...
303.1.3...
303.1.4 Fixed Guideway Transit Systems. Fixed guideway transit system buildings shall conform to the requirements of this code for their occupancy classification in addition to the provisions set forth in Section 414A.

SECTION 414A – FIXED GUIDEWAY TRANSIT SYSTEMS

414A.1 General
414A.1.1 Scope. The provisions of this chapter shall apply to building or structures defined as stations for fixed Guideway transit systems and shall supersede other similar requirements in other chapters of this code.
414A.1.2 Definitions. For the purpose of this chapter, certain terms are defined as follows:

***AUTOMATED FIXED GUIDEWAY TRANSIT SYSTEMS** is a fixed guideway transit system that operates fully automated driverless vehicles along an exclusive right-of-way.*

***CENTRAL CONTROL STATION (CCS)** is the operation center where the authority controls and coordinates the system-wide movement of passengers and trains from which communication is maintained with supervisory and operating personnel of the authority, and with participating agencies when required.*

***DESIGN FIRE SCENARIO** is the approved engineering analysis method which considers vehicle combustible load, fire transmission between vehicles, and a sequence of events over time to determine the peak heat release rate from a vehicle fire.*

***ELEVATED STRUCTURE** are structures not otherwise defined as surface or underground structures.*

***EMERGENCY MANAGEMENT PANEL (EMP)** is the location where all necessary on-site control and communication facilities are consolidated for effective response to emergency situations. The EMP shall include the following:*

1. Indication of manual pull boxes and automatic smoke detectors.
2. Indication of alarm signals from all suppression systems.
3. Capabilities for using station paging system.
4. Emergency telephone.

Additional items may be required subject to the authority having jurisdiction.

***ENCLOSED STATION** is a station or portion thereof that does not meet the definition of an open station.*

***ENGINEERING ANALYSIS (FIRE HAZARD/FIRE RISK ASSESSMENT)** is an analysis that evaluates all various factors that affect the fire safety of the system or component. A written report of the analysis shall indicate the fire protection method(s) recommended that demonstrates a level of fire safety commensurate with this standard.*

***FIRE CONTROL PANEL (FCP) (FIRE COMMAND POST)** is the location during an emergency, selected by the person in command, for controlling and coordinating the emergency operation.*

***FIXED GUIDEWAY TRANSIT SYSTEM** (The System) is an electrified transportation system, utilizing a fixed guideway, operating on right-of-way for the mass movement of passengers within a metropolitan area and consisting of its fixed guideways, transit vehicles and other rolling stock; power system; buildings; maintenance facilities; stations; transit vehicle yard; and other stationary and movable apparatus, equipment, appurtenances, and structures.*

***GUIDEWAY** is that portion of the transit line included within right-of-way fences, outside lines of curbs or shoulders, underground tunnels, cut or fill slopes, ditches, channels, waterways, and including all appertaining structures.*

***OPEN STATION** is a station that is constructed in such a manner that it is open to the atmosphere, and smoke and heat are allowed to disperse directly into the atmosphere. The following enclosed areas in open stations are permitted but limited to:*

- *1. Ticket/pass booths not exceeding 100 sq ft in area.*
  2. Mechanical and Electrical Spaces typically not used for human occupancy and necessary for the operation of a fixed guideway transit system. Such spaces shall be limited to two per

level.

3 Restrooms not exceeding 100 sq ft in area. A maximum of two restrooms are permitted per level.

***POINT OF SAFETY** is an enclosed fire exit that leads to a public way or safe location outside the structure, or at-grade point beyond any enclosing structure, or other area that affords adequate protection for passengers.*

***POWER SUBSTATION** is the location of electric equipment that does not generate electricity but receives and converts or transforms generated energy to usable electric energy.*

***STATION** is a place designated for the purpose of loading and unloading passengers, including patron service areas and ancillary spaces associated with the same structure.*

***STATION PLATFORM** is the area of a station used primarily for loading and unloading transit vehicle passengers.*

***SURFACE STRUCTURE** is any at-grade or unroofed structure other than an elevated or underground structure.*

***TRAINWAY** is that portion of the guideway in which the transit vehicles operate.*

***UNDERGROUND SYSTEM** is a system or that part of a system located beneath the surface of the earth or of the water.*

414A.2 Types of Construction.

***414A.2.1 Type of Construction.** Unless otherwise specified in this section, buildings or portions of buildings classed as stations of fixed guideway transit systems shall be minimum Type I, Type IIFR, or Type II one-hour construction and shall not exceed in area or height the limits specified in Sections 505, 506, and 507. Underground stations shall be a minimum Type I or Type IIFR constructions.*

Open stations may be of Type IIN construction and shall not exceed in area or height as required by Tables Nos. 5-C and 5-D for Type II one-hour construction.

414A.2.2 Mixed Occupancies.

***414A.2.2.1** Stations of fixed guideway transit systems shall be separated from other occupancies in accordance with Table 5-B for Group A Occupancies.*

***414A.2.2.2** The following areas shall be separated from public areas by a 2-hour occupancy separation wall:*

1 Electrical control rooms, auxiliary electrical rooms, and associated battery rooms.

2 Trash rooms.

3 Train control rooms and associated battery rooms

***414A.2.2.3** All power substations shall be separated from all other areas by a 3-hour occupancy separation wall with no openings to public areas.*

414A.3 Access and Exit Facilities

***414A.3.1 Occupant Load.** The occupant load for a transit station shall be based on the emergency condition requiring evacuation of that station to a point of safety. The station occupant load shall be the sum of the number of persons in the calculated train load of trains entering a station plus the entraining load of persons awaiting a train, during a specified time period. Not withstanding, the maximum occupant load shall not exceed the occupant load calculated in accordance with Section 1002.1.2 utilizing an occupant load factor of 7 square foot per person.*

***414A.3.1.1 Calculated train load.** The calculated train load is the number of passengers on trains simultaneously entering the station on all tracks in normal traffic direction during the peak 15-minute period.*

The following limitations to the calculated train load shall be applied:

1. No more than one train will unload at any one track to a platform during an emergency.

2. The load on any single train is limited to the maximum train capacity.

3. The maximum for the "calculated train load" should be the most passengers capable of occupying a train.

***414A.3.1.2 Entraining load (on platform awaiting train).** The entraining load is equal to the number of passengers that would accumulate on the platform in the time period equivalent to two headways or 12 minutes during the peak 15-minute period, whichever is greater. This entraining load is constrained as stated as follows:*

1. Special consideration shall be given to stations servicing areas where events occur that establish occupant loads not included in normal passenger loads. These would include such areas as civic centers, sports complexes, and convention centers.

2. Access to the platform and/or the station must be operationally constrained to a platform net area occupancy equivalent to 3 square feet per person. For anticipated platform entraining loads that would result in area occupancies of less than 3 square feet per person, the calculated platform load will be limited to the net platform area divided by 3 square feet per person.

3. At multi-platform stations, each platform shall be considered separately. Arrival of trains from all normal traffic directions, plus

their entraining loads, shall be considered

4. At concourses, mezzanines or multi-level stations, simultaneous platform loads shall be considered for all exit lanes passing through that area.

414A.3.2 Exits Required.

414A.3.2.1 Number of Exits. Stations shall have at least two exits placed a distance apart equal to not less than one half of the length of the maximum overall diagonal dimension of the station. Enclosed station platforms shall have a minimum of one exit stair from each end. Routes from platform ends into the underground guideway shall not be considered as exits for calculating exiting requirements.

414A.3.2.2 Capacity of Exits and Station Evacuation Time.

414A.3.2.2.1 Exit capacities shall be calculated on the basis of 22 inch wide exit lanes at the clear and narrowest point except that individual handrails may project into the required width as permitted by Chapter 10. Fractional lanes shall not be counted in measuring exit capacities except that 12 in. added to one or more lanes shall be counted as one-half a lane. Escalators 32 inches in width may be considered as 1½ lanes.

414A.3.2.2.2 There shall be sufficient means of exit to evacuate the station occupant load from the station platforms in 4 minutes or less (see Table 2-1, "Emergency Exit Capacity Calculations").

414A.3.2.2.3 The station shall also be designed to permit evacuation from the most remote point on the platform to a point of safety in 6 minutes or less.

414A.3.2.2.4 In at-grade or elevated structures so designed that the station platform is open to the elements and, when the concourse is below or protected from the platform by distance or materials as determined by an appropriate engineering analysis, that concourse may be defined as a point of safety, with AHJ concurrence.

414A.3.2.2.5 To calculate evacuation time, the walking travel time should be tabulated using the longest exit route and travel speeds indicated in C, Exit Width and Exit Lanes. To this time should be added the following factors:

1. (W_1-T_1) The waiting time at the vertical elements at platform level minus the longest walking travel time at platform level.
2. (W_2-W_1) The waiting time at the fare collection barriers minus the waiting time at the platform vertical circulation elements.
3. (W_3-W_2) The waiting time at the vertical or horizontal circulation elements from mezzanine to grade minus the waiting time at the mezzanine vertical circulation elements or fare collection barrier, whichever is greater.
4. (W_4-W_3) The waiting time, if any, at any additional constriction minus the greatest previous waiting time. (Repeat for all additional constrictions.)

Note: The total of any of the factors in (1) through (4) above cannot be less than zero.

414A.3.3. Exit Width and Exit Lanes.

414A.3.3.1 The capacity in persons per minute (ppm), patron travel speeds in feet per minute (fpm), and requirements for exit lanes shall be as follows:

1. Platforms, corridors, and ramps of 4 percent slope or less. Exit corridors, platforms, and ramps shall be a minimum clear width of 5 feet. In computing the number of exit lanes available, 1 foot 6 inches shall be deducted at each platform edge and one foot at each sidewall.

Per exit lane:

Capacity - 50 ppm
Travel speed - 200 fpm

2. Stairs, stopped escalators, and ramps of over 4 percent slope: Exit ramps shall be a minimum clear width of 6 feet. Stopped escalators may be considered as a means of egress, provided they are of nominal 2 feet 8 inches width.

Per exit lane "up" direction:

Capacity - 35 ppm
Travel Speed - 50 fpm*

Per exit lane "down" direction:

Capacity - 40 ppm
Travel Speed - 60 fpm*

(*Indicates vertical component of travel speed)

3. Doors and gates: Gates fitted with approved panic hardware and opening in the direction of exit travel, with minimum nominal width of 3 feet shall be permitted in exit calculation.

Per doors & gate: Capacity - 50 ppm per exit lane.

4. Fare collection gates: Fare collection gates, when deactivated, shall provide a minimum 20 in. clear unobstructed aisle. Console shall not exceed 40 in. in height.

Per gate: Capacity - 50 ppm

NOTE: For turnstiles see Section 3304(i.4) - (Section 3304i.4 is reformatted for '94 Edition.)

414A.3.4 Arrangement of Exits.
414A.3.4.1 Vertical circulation elements shall be comprised of stairs or stair/escalator combinations. Escalators shall not account for more than half of the units of exit at any one level in the public area. Escalators must be paired in combination with stairs in order to be included in exiting capacity calculations.
414A.3.4.2 Because of the possibility of maintenance or malfunction, one escalator at each station shall be considered as being out of service in calculating egress requirements. The escalator chosen shall be that one having the most adverse effect upon exiting capacities.

414A.3.5 Distance to Exits. *No point of the station platform(s) or mezzanine(s) shall be more than 300 feet from a point of safety.*

414A.3.6 Other Exits Required/Guideway Access.
414A.3.6.1 Access/egress between guideway platforms shall be provided as follows:

1. Stairs or ramps, 2 feet 10 inches, or other arrangement having equivalent capacity, shall be provided at each end of the platform, arranged to provide access/egress to trackway level.
2. Except in underground stations, the access points between the guideway and the platform; and the exit from the platform may be integrated.

414A.3.6.2 In enclosed stations, escalator and stairway enclosures are not required in the public areas of multi-level transit stations between platform, mezzanine, and concourse when the station is provided with emergency ventilation system.

414A.3.7 Emergency Lighting and Exit Signs.
414A.3.7.1 Emergency lighting and exit signs shall be provided in accordance with Chapter 10.

EXCEPTION: *Open Stations at grade need not provide emergency lighting or exit signs.*

414A.3.7.2 Power for emergency lighting and exit signs shall be independent of the Traction Power System.

TABLE 414A-1

EMERGENCY EXIT CAPACITY

CALCULATIONS

Station _____
Occupancy Load _____

EXIT LANES AND CAPACITY PROVIDED

PLATFORM TO MEZZANINE

Stairs _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

Escalators _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

Emergency Stairs _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

TOTAL _____ *PPM*

THROUGH FARE BARRIER

Fare Gates _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

Service/Emergency Gates _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

TOTAL _____ *PPM*

FARE BARRIER TO SAFE AREA

Stairs _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

Escalators _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

Emergency Stairs _____ x _____ *Lanes x* _____ *PPM* = _____ *PPM*

TOTAL _____ *PPM*

EMERGENCY EXIT CAPACITY TESTS

TEST 1

Evacuate station occupant load from station platform(s) in 4 minutes or less.

$$W_1 \text{ (waiting time at platform exits)} = \frac{W \text{ (occupancy load)}}{\text{Exit Capacity}}$$

$$W_1 = \frac{\text{Persons}}{PPM} = \_\_\_\_ \text{ Minutes}$$

TEST 2

Evacuate station occupant load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for Longest Exit Route

$T = T_1 + T_2 + T_3 + T_4 + T_5$

T_1 (platform) = _____ Feet – _____ FPM = _____ Minutes

T_2 (platform to mezzanine) = _____ Feet – _____ FPM = _____ Minutes

T_3 (mezzanine to fare barrier) = _____ Feet – _____ FPM = _____ Minutes

T_4 (fare barrier to safe area) = _____ Feet – _____ FPM = _____ Minutes

T_5 (grade) = _____ Feet – _____ FPM = _____ Minutes

T = _____ MINUTES

ADDITIONAL WAITING TIME AT PLATFORM EXITS

W'_1 _____ - T_1 _____ = _____ *Minutes*

ADDITIONAL WAITING TIME AT FARE BARRIER

Total Occupant Load _____ - *Emergency Stair 4 Minute Capacity* _____

= _____ *Occupant Load at Mezzanine*

$$W'_2 = \frac{\text{Mezzanine Occupant Load}}{\text{Gate Capacity}}$$

$$W'_2 = \frac{\text{Persons}}{\text{PPM}} = \text{_____ Minutes}$$

W'_2 _____ - W'_1 _____ = _____ *Minutes*

ADDITIONAL WAITING TIME AT MEZZANINE EXITS

$$W'_3 = \frac{\text{Mezzanine Occupant Load}}{\text{Exit Capacity}}$$

$$W'_3 = \frac{\text{Persons}}{\text{PPM}} = \text{_____ Minutes}$$

W'_3 _____ - W'_1 _____ = _____ *Minutes*

TOTAL EXIT TIME

T _____ + (W'_1 - T_1) _____ + (W'_2 - W'_1) _____ + (W'_3 - W'_1) _____ = _____ *TOTAL MINUTES*

414A.4 Special Provisions.

414A.4.1 Automatic Sprinkler System. An automatic sprinkler system shall be installed in all stations of Fixed Guideway Transit Systems.

EXCEPTIONS: 1. Trainways when closest sprinkler heads to the trainway are within three feet of the edge, over the platform, and spaced six feet on center parallel to the trainway.

2. Station Agent Booths not exceeding 100 square feet in area, when provided with an approved smoke detector connected to the building fire alarm system.

3. Power Substations

4. Machinery Rooms, Electrical Rooms and Train Control Rooms protected by an approved automatic fixed fire extinguishing system.

5. Open stations.

6. Station platform areas open to three or more sides.

414A.4.2 Station Trackway Deluge System. Below grade stations and open cuts with walls five feet above the top of the running rail shall be provided with an under-vehicle trackway manually operated deluge sprinkler system. In open cut stations, such system shall be provided in trackways which are situated between a platform edge and a retaining wall.

414A.4.2.1 Systems shall be provided along the entire length of track at each station. Each deluge system shall be zoned to protect a minimum length of two transit vehicles.

414A.4.2.2 Deluge nozzles with caps shall be located in the approximate center of track with spacing designed to completely wet the undersides of the vehicle at the applied density.

414A.4.2.3 System density shall be a minimum of .19 GPM per square foot. When more than one zone is provided, two adjacent zones are required to be considered operating for calculating purposes.

414A.4.2.4 Deluge systems shall be directly connected to a water supply with a minimum 30 minute duration.

414A.4.2.5 Controls or manually operable valves shall be in a protected location that is accessible to fire department personnel. All deluge systems shall be monitored by the station fire alarm system.

414A.4.2.6 Manual systems shall be monitored so that valves are in the closed position. Each valve shall be monitored by a separate circuit. The alarm panel shall be located in an area normally occupied by station personnel or signals shall be transmitted to a central station.

414A.4.3 Standpipe Systems.

414A.4.3.1 Underground stations shall be provided with a class III standpipe system designed to comply with the following:

1. Automatically supply the required flow at 65 PSI for each 1½ inch outlet.

2. Supply a 250 gpm flow to each of the two most remote 2½ inch outlets when pressurized through the fire department connection(s).

414A.4.3.2 All other stations shall be provided with a class I manual wet standpipe system.

EXCEPTION: Open at-grade stations with unrestricted fire department access need not be provided with a standpipe system.

414A.4.3.3 Standpipes shall be located such that all portions of the station are within 130 feet of an outlet.

414A.4.4 Ventilation. Emergency ventilation shall be proved for enclosed and underground stations for the protection of passengers, employees and emergency personnel.

414A.4.4.1 The ventilation system shall be designed as follows:

1. A stream of noncontaminated air is provided to passengers in a path of egress away from a train fire; and

2. Airflow rates produced towards a train fire in a path of egress are sufficient to prevent back layering of smoke; and

3. the temperature in a path of egress away from a train fire is limited to 120 degrees fahrenheit, or less.

414A.4.4.2 Ventilation shaft terminals at-grade shall be located as follows:

1. Openings for blast relief shafts, and underplatform and smoke exhaust shafts at-grade shall be separated by a minimum horizontal distance of 40 feet from any station entrance, elevator hoistway enclosure, surface emergency stair doorway, unprotected outside air intake may be adjacent to each other.

2. Where this distance is not practical, the horizontal distance may be reduced to 15 feet if the closest blast relief or underplatform and smoke exhaust shaft terminal is raised a minimum of 10 feet above the station entrance, emergency stair doorway and unprotected outside air intake or other opening, or the underplatform and smoke exhaust shaft terminal is raised a minimum of 10 feet above the blast relief shaft terminal.

3. Ventilation of stations shall not terminate at grade on any vehicle roadway.

414A.4.4.3 Emergency Ventilation Fans.

414A.4.4.3.1 Ventilation fans used for emergency service, their motors, and all related components exposed to the ventilation airflow shall be designed to operate in an ambient atmosphere of 482 degrees fahrenheit for a period of at least one hour. Ventilation fans and related components shall be capable of withstanding the maximum anticipated plus/minus pressure transients induced by train operations.

414A.4.4.3.2 Local fan motor starters and related operating control devices for emergency ventilation

equipment shall be isolated from the ventilation airflow by a separation having a fire-resistance rating of at least one hour.

414A.4.4.3.3 *Fans required for emergency operation shall be capable of satisfying emergency air-velocity criteria in either supply or exhaust modes.*

414A.4.4.3.4 *Sufficient emergency ventilation shall be provided with one of the most critical ventilation fans out of service.*

414A.4.4.3.5 *Thermal overload protective devices shall not be provided on motor controls of fans used for emergency ventilation.*

414A.4.4.3.6 *Two power feeders from separate sources shall be provided for each of the emergency fans. Power feeders furnishing power for fans shall be physically isolated from each other and shall originate from separate distinct sources. Automatic transfer shall be provided in the event the normal supply source fails.*

414A.4.4.3.7 *Operation and fail-safe verification of proper operation emergency fans shall be effected from a central control station with indication provided for all modes of operation for each fan.*

414A.4.4.3.8 *Local controls shall permit overriding remote central supervising control. Local control shall be capable of operating the fans in all modes in the event the remote controls become inoperative.*

414A.4.4.4 Ventilation Control.

414A.4.4.4.1 *Emergency ventilation systems shall be supervised and/or controlled in all operating modes locally (motor control center and/or fan unit) and remotely at both the CCS and at the station EMP. Local controls and EMP controls shall have primary and secondary overriding capability, respectively.*

414A.4.4.4.2 *Fan running shall be proven by sensing devices for each fan for operation in both the supply and exhaust directions. Air movement at 90% of rated air flow shall be required to initiate the fan-running signal for both the high-speed and low-speed modes. Fan speed and direction shall be controlled and status fully annunciated at remote control locations.*

414A.4.4.4.3 *Local control shall be from a protected location near the fans separated from other areas by two hour fire-rated construction.*

414A.4.4.4.4 *Trouble status signals shall be annunciated in the local control room. A summarized trouble signal shall be annunciated at CCS and EMP.*

414A.4.4.5 Ventilation Systems and Ancillary Areas.

414A.4.4.5.1 *Ancillary area ventilation systems shall be arranged so that air is not exhausted into station public occupancy areas.*

414A.4.4.5.2 *Storage battery or similar ancillary rooms in which hydrogen gas or other hazardous gases may be released shall require mechanical ventilation and shall be ventilated as follows:*

1. Exhaust ducts from battery rooms shall not connect with duct systems used for other purposes.

2. The battery exhaust ventilation system shall be provided with electrical power and air flow interlocks that will prevent operation of the battery charger if the ventilation fan motor is not energized or the air velocity in the exhaust duct is less than the designated velocity.

3. For functions that cannot tolerate de-energization of battery charging equipment, other protective means approved by the authority having jurisdiction (i.e. gas monitoring, additional fan(s), delayed timer, etc.) may be provided to delay the activation of the interlock. This configuration additionally requires the appropriate power transfer devices and remote status alarms/indications reporting to the CCS.

414A.5 Fire Alarm and Communication Systems.

414A.5.1 General. *Every station shall be provided with a state fire marshal-approved and listed fire alarm system. The alarm and communication systems shall be proprietary, designed and installed so that damage to any one speaker will not render any paging zone of the system inoperative.*

EXCEPTION: *Open at-grade stations with unrestricted fire department access.*

The voice alarm and public address system may be a combined system. When approved by the fire department, a communications system may be combined with the voice alarm system and the public address system. Such combined systems shall meet the requirements of the California Electric Code.

414A.5.2 System Components. *Each station fire alarm system shall consist of:*

1. Fire Alarm Control Panel at a location as permitted by the Authority Having Jurisdiction.

2. An alarm annunciator(s). The annunciator(s) shall be located at a point acceptable to the Authority Having Jurisdiction. The annunciator(s) shall indicate the type of device and general location of alarm. All alarm, supervisory and trouble signals shall be transmitted to the local annunciator(s) and the proprietary supervising station.

3. Manual pull stations shall be provided throughout passenger platforms and stations.

EXCEPTION: Voice alarm reporting devices (Emergency Telephones) may be used in lieu of manual pull stations as permitted by the Authority having jurisdiction.

Such devices shall provide two-way communication between the proprietary supervising station and each device. Such devices shall be located as required for manual fire alarm pull boxes, and shall be distinctly identified by signs, coloring, or other means acceptable to the Authority Having Jurisdiction.

4. Automatic smoke detectors in all ancillary spaces

5 Automatic control of exiting components.

414A.5.2 Combined Voice Alarm/Public Address System. *Each station shall be provided with a one-way paging system(s) capable of transmitting voice, tape or electronically generated messages to all areas of the station. The system(s) shall be configured such that the messages can be initiated from either the EMP or the proprietary supervising station.*

414A.5.3 Public Telephones. *Public telephones shall be provided in a central location on each level having public access.*

414A.5.4 Emergency Telephones. *A dedicated emergency phone system shall be provided in all underground trainways to facilitate direct communications for emergency response between remote locations and the Emergency Management Panel at the nearest stations or between a station and portal. The remote phones shall be located at all accessways to the underground, ends of station platforms, plug-ins at each Fire Department inlet connection, each hose outlet connection, station valve rooms, and such that at least one phone location is visible from everywhere in the underground.*

AUTHORITY & REFERENCE

Authority: Health & Safety Code Sections 13108 and 13143.
Reference: Health & Safety Code Sections 13108 and 13143.

THE FOLLOWING ARE THE REASONS FOR PROPOSING THIS PARTICULAR RULEMAKING ACTION.

Mass transit buildings typically accommodate thousands of passengers every day. Currently the California Building Code does not adequately address the special needs of this type of use, and the State has not adopted NFPA 130 which is commonly utilized by transit agencies throughout the country. Due to the lack of specific criteria within the California Building Code, local fire authorities do not have a method for uniform enforcement of design or construction standards.

Health and Safety Code Section does not prohibit local jurisdictions from enacting more stringent requirements for assembly type occupancies. Stations of fixed guideway transit systems (FGTS), although they meet the use requirements for assembly type occupancies, they are not designed like a typical assembly type occupancy. Because the State adopts Title 24 for assembly occupancies and not NFPA 130, the standard for FGTS; local jurisdictions pick and choose independently when to utilize the specifics of NFPA 130 as it relates to FGTS via Section 113(b), Title 24 CBC. This type of inconsistency does create a significant cost factor towards project management and budgeting. FGTS property owners find it impossible to budget proposed FGTS which span across multiple jurisdictions.

These regulations were developed by an Ad Hoc committee consisting of fire service, property owners, and fire protection consultants. The committee, while chaired by the Office of State Fire Marshal, is endorsed by the California Fire Chiefs Association and the California Transit Association. These regulations, while still minimum requirements only, address most fire and life safety issues found in stations of FGTS's.

The agency has determined that no alternative would be more effective in carrying out the purpose for which the regulation is proposed or would be less burdensome to affected private persons than the proposed regulation.

ITEM 6 COMMITTEE ACTION [BFO]

SFM 8/95 **Approve**

RECOMMENDATION REASON:
Approval of a proposed code change as submitted. The proposed code change is justified in terms of H&SC §18930.

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APPENDIX B

PRELIMINARY INPUT RECEIVED FROM THE SAN FRANCISCO FIRE DEPARTMENT

Based on two exploratory meetings with the SFFD, following are some very general requirements put forth by the Department:

1. Fire Walls between opposing tracks, wherever possible, with opening every 400 to 500 feet

2. Wet stand pipe (fire protection water) throughout the subway portions located in the upper reaches of the cross-section.

3. Ingress/egress shafts/facilities to each separate subway box at an optimum spacing of every 1200'.

4. Emergency walkways in each separate subway box with a minimum width of 3'-2". (38")